THE

POPULAR SCIENCE MONTHLY

APRIL, 1888.

COLLEGE ATHLETICS AND PHYSICAL DEVELOPMENT.

By Professor EUGENE L. RICHARDS,
of Yale College.

IN an article on "The Physical Proportions of the Typical Man,"* Dr. Sargent has taken occasion to speak of athletics in connection with the general subject of physical development. In the following pages I wish to show that neither in that article nor in the subsequent article, on the "Physical Characteristics of Distinguished Athletes,"† did he do justice to the influence of athletics in "reminding the individual of the ultimate aim of every kind of physical exercise"; that his remarks on the loss resulting to athletics from "making excellence in achievement the primary object" of them would have had more force if they had been more discriminating; and, finally, to present some statistics which lead to conclusions favorable to athletics.

"Every writer on education, from Plato to Herbert Spencer, has advocated physical activity as a means of attaining that full-orbed and harmonious development of all parts of the human economy so essential to robust, vigorous health." Theorists, then, are agreed upon this as the "ultimate aim of every kind of physical exercise." But we all know how difficult it is to get the best theories put into practice. They may commend themselves as the very best, but they fall far short of their good to men till they can be made working theories. In this respect the "harmonious-development" theory, whether mental or physical, forms no exception to other theories. But once get hold of some motive by which to induce even a few individuals to put a theory into practice, and half the battle is won. If it is a really good theory, its own practical examples prove the fact. "Wisdom is justified of her

* "Scribner's Monthly," July, 1887. † Ibid., November, 1887.

children." Here is always the difficulty—to get hold of the motives which will influence men and women in such way that they may finally be possessed by the "love of symmetry in form" which has such "a deep moral significance." You may preach the doctrine to children, and your words will be like the idle wind. Even our young men and our maidens will prefer snug-fitting garments and handsome raiment covering a bad form, to the proportions of Apollo or the beauty of the Venus of Milo not clothed in the fashions of the day. Many men and women, staggering along under burdens of ill-health, self-imposed by neglect of the simplest natural laws, will give your beautiful theory small thought. They will pursue their phantoms of wealth and ambition, while they hug the delusion that they suffer by God's will in this "vale of tears." They do suffer, and deservedly, but only because they do not use their own wills to conform their conduct to His good-will as revealed in the constitution of their own being. It is useless to set forth to such people the truths of health, the glad tidings of deliverance from many of their ailments by the natural remedies of air, exercise, and food. The doctrines of health have always been preached, and men have not heeded. Let us begin, then, with children, and *educate* them to these high truths. But with children we have to use authority or play upon motives. If we use authority merely, the idea of harmonious development will become distasteful to them. They will break away from authority and break with the theory at the first opportunity of liberty. Put them at what we elders call play, and they often accomplish of their own free-will what we with difficulty get out of them by force. Now I say that, by their various athletic organizations, young men are doing this very thing for themselves that children do in play. They establish in the colleges a system of training for their various sports which affects not only the members of the higher institutions of learning, but which reaches almost every young man in the land. To express the idea in Dr. Sargent's words, "the college clubs look to the academies, the academies to the schools, the schools to the homes and firesides, to furnish candidates for athletic honors." Dr. Sargent proposes this as one of his objections to making "excellence in achievement the primary object of athletic exercise." But it is the reward which this same "excellence in achievement" receives that brings forward good material and stimulates an increasing number of men to exercise, who would never think of doing so without this stimulus. One is at a loss to understand how this fact should account (as Dr. Sargent says it does account) for the "lack of active interest in athletics." On the contrary, it is one of the principal causes of that active interest; it keeps young men in training, holds them to regular, systematic exercise, in season and out of season, through an important and critical period of their growth; it sends them into the gymnasium when the season forbids practice in the field; it restrains them from excesses, from smoking and drinking, and from late hours;

it brings the whole force of college opinion to bear in favor of a healthy, moral life. To be sure, the desire to defeat a rival club or team is not the highest motive of the human mind; the honor of winning a medal in a race is not the greatest honor which earth can afford. The glory of being champions at any game seems puerile to serious-minded people; but we must take young people as we find them. If we can not induce them to exercise by the "deep moral significance" of "the beauty of symmetry of form," we must lay hold of the motives, not wrong, which do influence them. The majority of them not being open to the highest motives, we take the next best motives which appeal to them. That is the principle on which all education is conducted. Competitions, prizes, medals, honors, appeal to students, move them, and hold them to efforts which higher and worthier objects fail to call forth. By these we educate them to habits which fit them to receive the higher motives. They are their schoolmasters to train them for a better life. So it is in athletic sports. By habits of exercise from earliest youth young men are educated to appreciate the value of it. Accustomed to feel the good effects of it in themselves, or to see the good of it in the person of some upholder of the honor of their club, they learn to admire the cause of this good. The prominent athletes present examples of beauty of form and vigorous health. The sight of them stimulates many a man to try on his own person the effect of the training which he sees embodied in the winners of prizes or championships. More than this, having once learned the value of exercise to health, he forever associates together health and exercise in a necessary companionship. So the athletes preach to all men by example.

We will now consider the various athletic sports, in order that we may weigh the justice of Dr. Sargent's remarks on the evils of making "excellence in achievement" their "primary object." We may eliminate from the sports certain ones not liable to these evils, such as have for their object a victory, not a prize. To the contestants the importance of match-games of foot-ball, base-ball, lacrosse, and polo lies not in excellence of achievement, but in defeating rival organizations. The big score may be desirable, but the principal aim is the championship. Rowing, also, may be said to be free from these evils, because, though "good form" and the best stroke may be aimed at, the principal purpose is to put the boat over the course fast enough to come in first at the finish. Excellence in achievement consists in winning the race. Fast time may be acceptable, but, if the winning boat makes the fastest time for its particular race, the winning crew is satisfied.

If, therefore, we remove base-ball, foot-ball, and rowing from the list of athletic exercises which are liable to the evils following from "making excellence in achievement" "the primary object" of them, Dr. Sargent's seven specifications can not apply to them. Some of

them may apply on other grounds, but not as corollaries of "excellence of achievement." Some of them do not apply at all; viz., robbing them of half their value—III. "*By reducing the number of active competitors*"; IV. "*By relying upon natural resources rather than upon cultivated material*"; V. "*By depriving the non-athletic class of every incentive to physical exertion.*"

"III" is disproved by the fact (only necessary to be mentioned in order to be admitted) that the number of active competitors has increased so much, especially in the colleges, that instead of contests between a few clubs in one large association, the contests are now between many clubs in many associations.

"IV" has already been noticed, but the question might be raised whether it were possible to look for material from any other than "natural resources." If it were, does not "IV" conflict with "II," in which "making excellence in achievement the primary object of athletics" is said to "rob them of half their value" "*by increasing the time devoted to practice*"?

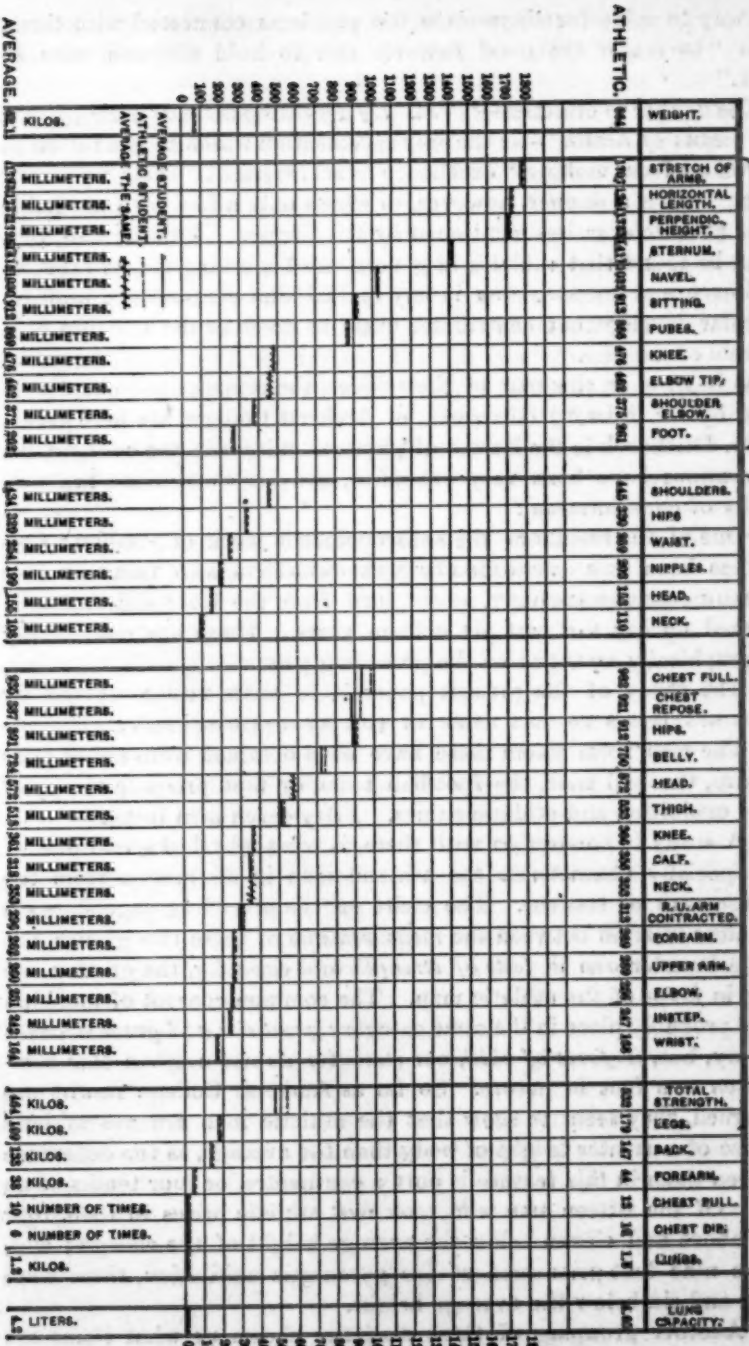
"V" is not true, as the non-athletic class is continually being stimulated to exercise by the example of the athletic class, a fact on which I have already commented.

The objections of expense and time I have considered elsewhere,* but will assert here that, in these respects, athletics merely keep pace with other undertakings of modern times. More money is spent upon education than formerly. More money goes to gymnasiums. There is more money in the land. Success as well as failure costs more. But we are getting better results. We are inducing more people to exercise. The increased cost is due to the better results. Like every other good, exercise costs something. The real question is, whether the results are worth the cost. I think they are. I maintain that the saving to the health and morals of our young men all over the land is worth the whole cost of their athletic organizations.

As to time, it is undoubtedly true that some young men spend too much time in athletic exercises, but the majority of them do not do so. They spend no more time than is good for them, at a period of their lives when they are laying up physical capital. And the fact that, to be well prepared for contests, successful athletes have to keep in training the greater portion of the year, instead of during a small part of it, as formerly, is one of the best features of the present system of athletics. It gives them healthy occupation for their leisure moments, and enforces habits of good living all the year, instead of for a few months.

To "VI" I have very little to say, except to express a more hopeful spirit with regard to the future of "all competitive sports which bring men into personal contact." Putting boxing out of the list, it seems to me that young men interested in the other sports are in a

* "Popular Science Monthly," March, 1884.


PHYSICAL MEASUREMENTS AND TESTS OF THE AVERAGE, AND THE ATHLETIC STUDENT IN AMHERST COLLEGE, MARCH, 1897.
AVERAGE.
ATHLETIC.
AVERAGE STUDENT.
ATHLETIC STUDENT.
AVERAGE THE SAME.
LENGTHS.
BREADTHS.
GIRTHS.
TESTS.
WEIGHT. KILOS. 64.4
STRETCH OF ARMS. MILLIMETERS. 1787 1841
HORIZONTAL LENGTH. MILLIMETERS. 1757 1811
PERPENDIC. HEIGHT. MILLIMETERS. 1741 1801
STERNUM. MILLIMETERS. 1041 1081
NAVEL. MILLIMETERS. 913 966
SITTING. MILLIMETERS. 878 948
PUBES. MILLIMETERS. 878 948
KNEE. MILLIMETERS. 470 510
ELBOW TIP. MILLIMETERS. 370 410
SHOULDER ELBOW. MILLIMETERS. 361 390
FOOT. MILLIMETERS. 361 390
SHOULDERS. MILLIMETERS. 449 530
HIPS. MILLIMETERS. 369 390
WAIST. MILLIMETERS. 330 369
NIPPLES. MILLIMETERS. 290 330
HEAD. MILLIMETERS. 153 170
NECK. MILLIMETERS. 110 130
CHEST FULL. MILLIMETERS. 960 1021
CHEST REPOSE. MILLIMETERS. 913 960
HIPS. MILLIMETERS. 760 870
BELLY. MILLIMETERS. 670 825
HEAD. MILLIMETERS. 565 596
THIGH. MILLIMETERS. 506 556
KNEE. MILLIMETERS. 363 413
CALF. MILLIMETERS. 313 369
NECK. MILLIMETERS. 369 389
R. U. ARM CONTRACTED. MILLIMETERS. 309 326
FOREARM. MILLIMETERS. 267 286
UPPER ARM. MILLIMETERS. 247 286
ELBOW. MILLIMETERS. 167 186
INSTEP. MILLIMETERS. 167 186
WRIST. MILLIMETERS. 138 147
TOTAL STRENGTH. KILOS. 538 179
LEGS. KILOS. 147 44
BACK. KILOS. 113 36
FOREARM. KILOS. 36 LB
CHEST FULL. NUMBER OF TIMES. 36 LB
CHEST DIL. NUMBER OF TIMES. LB
LUNGS. KILOS. LB
LUNG CAPACITY. LITERS. 4.60
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800

fair way to solve for themselves the problems connected with them, so as "to retain the good features and to hold the evil ones in check."

The danger to athletics—"VII. *By depriving them of their efficacy as a means of health*"—is the only specification which might follow as a corollary from making "excellence in achievement" their "primary object." It is a danger, however, to which only a few men are liable in the athletic exercises mentioned by Dr. Sargent. I think, also, that it will be found that athletes in general are beginning to learn that to excellence and success, even in any special kind ofexercise, a uniform muscular development contributes quite as much as the training of a few sets of muscles.

As bearing on this part of the subject, the remarks and chart published by Dr. Edward Hitchcock, of Amherst College, are here given. As Dr. Hitchcock is the Nestor of physical culture in the colleges, his observations have been very extensive, and his conclusions are well worthy of consideration:

"One of the results of the anthropometric work of Amherst College has been THE APPROXIMATE MEASUREMENTS AND TESTS OF THE AVERAGE COLLEGE STUDENT, as obtained from the 1,258 different men observed during the past six college years. These are numerically and graphically arranged on the preceding page.

"The study of the present paper is to show THE RELATION OF THESE STATISTICS TO THE SAME IN THE ATHLETIC STUDENT.

"The men from whom these have been obtained were either class captains, the ball nine, the foot-ball team, or first prizes in the gymnastic exhibition and athletic games. Fifty-seven men in all.

"A study in connection with these, is what physical conditions, if any, specially characterize the athletic man in distinction from the average man or student. The chart on the preceding page shows a very close relation between the *measurements* of these two groups, but a little broader one in *tests of strength and capacity*, the greater one being in favor of the athletic man. The common consent of mankind would probably place in the same category *great size and great strength* of body, but, *in feats of skill*, our *statistics do not confirm this combination* as a fact in nature. So far as Amherst College results are concerned, they seem to show that the athletic men are not athletic because of a greater height of body than the average, as the difference between them in this feature is only a centimetre, or four tenths of an inch. Of the fifteen men who took first athletic prizes in 1886, four were above and eleven below the average height of the college; and, of the nine first-prize men at the gymnastic exhibition, three were above and six below the average height.

"Another grouping of these statistics shows us what items are most alike in the make-up of these men. As already mentioned, the heights are nearly the same. So are the lengths and other measures

of the framework, such as sitting height, length of arms and feet, and the breadths, which are determined by the bones as a basis of measurement. Of *eighteen bony measurements*, twelve give no greater difference than a single millimetre, or one hundredth of one per cent between the two. Of eleven of the *soft* or *muscular measures*, including the variable and developmental parts of the body, the range of difference is from five to forty-seven millimetres, or 3·3 per cent differences between the two. And of the tests of *strength and capacity* we find an average of 7·2 per cent in favor of the athletic man.

"Or we may group the items as in the graphic form. Here we find the increase in favor of the athletic student in *weight* is 6·92 per cent; in *lengths*, 0·14 per cent; in *breadths*, 1·42 per cent; in *girths*, 2·56 per cent; and in *tests*, 10·24 per cent.

"The grain of truth derived from these pages seems to be that athletism does not seem to depend so much on physical gifts, accidents, or circumstances, as in the energy of will which is put into the muscles. The long arm and leg and the big muscle do not insure the feat, but the skill in using them. It is the intelligent training, and not the big measures, which determine the standards of excellence in our athletic feats and sports.

"President Garfield said: 'There is no way in which you can get so much out of a man as by training; not in pieces, but the whole of him; and the trained men, other things being equal, are to be the masters of the world.'"

At no college in the land is more careful attention given to physical development by means of gymnastic exercises than at Amherst. If, therefore, Dr. Sargent's statements were true with respect to partial development by athletics, the fact ought to show in these averages, and specially against the athletic student. The contrary fact appears.

Notice Dr. Hitchcock's conclusion, that "athletism does not seem to depend so much on physical gifts, accidents, or circumstances, as in the energy of will which is put into the muscles. . . . It is the intelligent training, and not the big measures, which determine the standard of excellence in our athletic feats and sports." This will-power, guided by intelligence, makes not only successful athletes, but successful men. The training which young men receive in their sports possesses its highest value by virtue of the fact that it brings forth some of the best powers of mind and character, not because it develops mere bone and muscle.

Whether averages conceal or prove facts depends upon the interpretation of them. Dr. Sargent's charts would be more valuable to the public if he would give his data. The figures, by means of which the measurements of the "typical or normal standard" are derived, furnish the key to the chart. No man can test himself by the standard till he knows the standard measurements. The charts may be

interesting and profitable as a private study, but can be of no benefit or authority to a single individual till Dr. Sargent discloses the measurements of the "typical man."

The real question with regard to athletics in the colleges, *as far as measurements are concerned*, is this: "What effect do athletics have upon the *growth* of athletes, as compared with the growth of those who are not athletes, but who are otherwise under similar conditions?"

To throw light on this question, the writer obtained from Dr. Seaver, of Yale College, two sets of measurements of members *of one class*, so as to ascertain the *growth for one year*. The first set of measurements was made soon after the class entered college, and the second set was taken in its sophomore year. Complete double measurements were procured from one hundred and two men, the remainder of the class—between twenty and thirty men—having neglected to submit to the second measurement. Of these, twenty-two were out-of-door athletes, and eighty were not, though they were under instruction in light gymnastics during a large part of their freshman year. The question, therefore, was considered under conditions as favorable as possible to Dr. Sargent's point of view. The results are presented graphically on page 729 and in numbers on page 730.

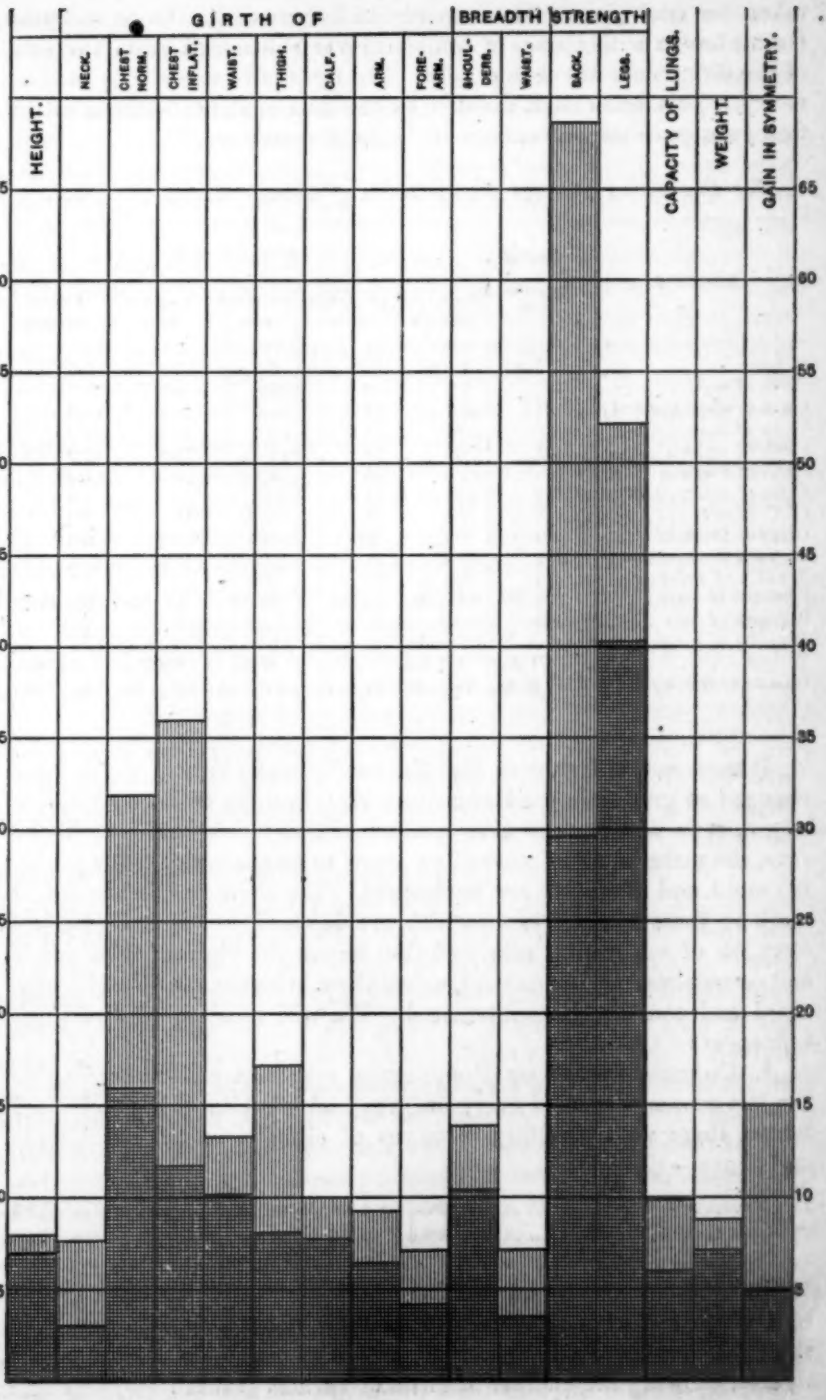
In the table, the items of *strength* of back and legs, and of weight, are given in pounds. Capacity of lungs is given in cubic inches. The other figures denote millimetres and tenths of millimetres.

The chart gives the average growth of the athletes as compared with the growth of the non-athletic men. The lighter parts of the chart indicate the excess of growth of one class above the growth of the other.

Of the twenty-two athletes two were base-ball players, six foot-ball players, six rowing-men, and eight were track-athletes. Of the foot-ball men five were also rowing-men. The averages are given for the four sets of men, as well as for the two classes (non-athletic and athletic), that the reader may see for himself how each kind of exercise has affected those taking it. The figures for the special athletes are derived from so small a number of men that they can hardly be taken as *conclusive*. They are merely *significant*. The small gain in the average of "strength of legs" of the foot-ball men was due to the loss of strength on the part of one man. Without him the remaining five gained an average of forty-eight pounds.

The growth of *girth of neck* of the athletes, in comparison with the same item for the non-athletic men, is worthy of attention. The gain in *strength of back* of the track-athletes, and their gain in *strength of arm*, ought to be noticed.

To test the question of symmetry of growth, the differences between the sizes of right arm and left arm, of right forearm and left forearm, of right thigh and left thigh, of right calf and left calf, were


GIRTH OF
BREADTH
STRENGTH
HEIGHT.
NECK.
CHEST NORM.
CHEST INFLAT.
WAIST.
THIGH.
CALF.
ARM.
FORE-ARM.
SHOULDERS.
WAIST.
BACK.
LEGS.
CAPACITY OF LUNGS.
WEIGHT.
GAIN IN SYMMETRY.
65
60
55
50
45
40
35
30
25
20
15
10
5

taken for *each year*. The sum of the differences of the second year (being less in both classes of students) was subtracted from the sum of the differences of the first year. The remainder was a gain in symmetry. This remainder, divided by the sum of the differences of the first year, gave the percentage of "gain in symmetry."

For One Class: Average Measurements of Growth during One Year.

GROWTH.	Rest of class: 80 non-athletes.	OUT-DOOR ATHLETES.				
		22 out-door athletes.	2 base-ball men.	6 foot-ball men.	6 rowing-men.	8 track-athletes.
Height	7·2 mm.	8 mm.	8·5 mm.	7·5 mm.	11·3 mm.	5·75 mm.
Girth of neck	3	7·7	6	11·3	5·7	7
Girth of chest (normal)	16·1	32·1	11	35·3	31·3	35·2
Girth of chest (inflated)	11·7	36·2	15·5	33·8	40·7	39·7
Girth of waist	10·1	13·3	23	11	15·8	11·9
Girth of thigh	8	17·3	16	15·7	15·2	21·2
Girth of calf	7·6	10·1	11	12·8	10	7·9
Girth of arm	6·3	9·3	9	7·7	11	9·2
Girth of forearm	4·2	7·1	2·5	9·5	6·7	6·9
Breadth of shoulders	10·4	13·8	12·5	11·5	11·7	17·4
Breadth of waist	3·4	7·2	10	5·5	6·8	8
Strength of back	29¼ lbs.	68·4 lb.	30 lbs.	55 lbs.	63¾ lbs.	91½ lbs.
Strength of legs	40½	52·3	45	19	51¼	81½
Capacity of lungs	5·9 cu. in.	9·7 cu. in.	12·2 cu. in.	7·6 cu. in.	10·2 cu. in.	10·3 cu. in.
Weight	7·1 lbs.	8·7 lbs.	7½ lbs.	9 lbs.	9·6 lbs.	8 2 lbs.
Gain in symmetry	4½ p. ct.	15 p. ct.	34 p. ct.	24 p. ct.	5½ p. ct.	4½ p. ct.

It must not be forgotten that the conditions of American life have changed so greatly in the last century that, in order to view education aright, it is necessary to take counsel of new considerations. To be sure, the material to be worked on seems to be the same. The youthful mind and character are unchanged. Yet there are influences at work in these modern times which are destined to sap the physical strength of our young men, and thus impair the vigor of their minds and emasculate their characters, unless these influences be clearly recognized and continually counteracted. We will mention two of these influences:

1. Concentration of Population into Cities.—According to the last census report, of every one hundred inhabitants in the United States, there were dwelling in towns of eight thousand inhabitants and above—

In 1790	3·3	In 1850	12·5
" 1820	4·9	" 1880	22·5

But these figures do not tell the whole story. Towns have grown into cities, and cities have added to their population enormously in the thirty years from 1850 to 1880, as will be seen from the following figures, showing the number of cities of various grades:

Number of Cities having Inhabitants of

IN	20,000 to 40,000.	40,000 to 75,000.	75,000 to 125,000.	125,000 to 250,000.	250,000 to 500,000.	500,000 to 1,000,000.	Over 1,000,000.
1850.....	14	7	3	3	1	1	0
1880.....	55	21	9	7	4	3	1

At the last census fifty cities held 15$\frac{4}{10}$ per cent of the aggregate population of the country. Whatever may be said in favor of city life for adults, nothing can be said in favor of its influence upon the vigor or morals of young men. Life in the cities is faster than in the country. The incentives to excess in mental work are greater. The wear and tear of the nervous system is more intense. At the same time the opportunity or necessity of physical effort for the young men of the well-to-do classes is reduced to a minimum.

2. Increasing Knowledge demanding more Brain-Culture.—Thus increasing demands are made upon the brain and nerves by the faster life of the cities, and by the need of a better culture to meet the competitions of that life, while the opportunities are lessened for strengthening the body against these demands. When the population was extensively engaged in rural or mechanical pursuits, without the division of labor which now obtains, the bodies of our young men were hardened by toil and invigorated by life in the open air.

That the concentration of population is reflected in the attendance at our colleges can be established by an examination of catalogues. The fact is certainly evident at Yale University, as will be seen from the accompanying figures. Of every one hundred students in the catalogue, there were registered as coming from cities of thirty thousand inhabitants and upward—

IN CATALOGUE OF	Academic department.	Sheffield Scientific School.
1856–'57	21$\frac{1}{2}$	18
1871–'72	44	39
1886–'87	55	58

Anything that will help to counteract the disintegrating forces of city life, that will help to strengthen our city young men against the insidious forces of ill-health, against the forces of low-living, that will tend to keep young men out of disorders, out of crimes against self and society, is to be welcomed as an ally of the best education. I maintain that the system of athletics existing at our colleges and in our athletic clubs in all the cities of the land does this. It does more. Its work is not only to save but to form men. It helps our schools and colleges to send out into the world not merely scholarly ascetics, but men full of force and energy, men of strong fiber, physical and moral.

The modern gymnasium is a necessary auxiliary to every well-equipped college, but it owes much of its increasing usefulness and importance to the fact that it is a training-place for athletes. There is no real antagonism between the athletic field and the gymnasium. It is not necessary to depreciate one in order to exalt the other. Existing side by side, and both rightly used, they will best contribute to the evolution of the "typical man."

THE STRUGGLE FOR EXISTENCE: A PROGRAMME.

By Professor T. H. HUXLEY.

THE vast and varied procession of events which we call Nature affords a sublime spectacle and an inexhaustible wealth of attractive problems to the speculative observer. If we confine our attention to that aspect which engages the attention of the intellect, Nature appears a beautiful and harmonious whole, the incarnation of a faultless logical process, from certain premises in the past to an inevitable conclusion in the future. But if she be regarded from a less elevated, but more human, point of view; if our moral sympathies are allowed to influence our judgment, and we permit ourselves to criticise our great mother as we criticise one another—then our verdict, at least so far as sentient Nature is concerned, can hardly be so favorable.

In sober truth, to those who have made a study of the phenomena of life as they are exhibited by the higher forms of the animal world, the optimistic dogma that this is the best of all possible worlds will seem little better than a libel upon possibility. It is really only another instance to be added to the many extant, of the audacity of *a priori* speculators who, having created God in their own image, find no difficulty in assuming that the Almighty must have been actuated by the same motives as themselves. They are quite sure that, had any other course been practicable, he would no more have made infinite suffering a necessary ingredient of his handiwork than a respectable philosopher would have done the like.

But even the modified optimism of the time-honored thesis of physico-theology, that the sentient world is, on the whole, regulated by principles of benevolence, does but ill stand the test of impartial confrontation with the facts of the case. No doubt it is quite true that sentient Nature affords hosts of examples of subtle contrivances directed toward the production of pleasure or the avoidance of pain; and it may be proper to say that these are evidences of benevolence. But if so, why is it not equally proper to say of the equally numerous arrangements, the no less necessary result of which is the production of pain, that they are evidences of malevolence?

If a vast amount of that which, in a piece of human workmanship,

we should call skill, is visible in those parts of the organization of a deer to which it owes its ability to escape from beasts of prey, there is at least equal skill displayed in that bodily mechanism of the wolf which enables him to track, and sooner or later to bring down, the deer. Viewed under the dry light of science, deer and wolf are alike admirable; and, if both were non-sentient automata, there would be nothing to qualify our admiration of the action of the one on the other. But the fact that the deer suffers while the wolf inflicts suffering engages our moral sympathies. We should call men like the deer innocent and good, men such as the wolf malignant and bad; we should call those who defended the deer and aided him to escape brave and compassionate, and those who helped the wolf in his bloody work base and cruel. Surely, if we transfer these judgments to Nature outside the world of man at all, we must do so impartially. In that case, the goodness of the right hand which helps the deer, and the wickedness of the left hand which eggs on the wolf, will neutralize one another; and the course of Nature will appear to be neither moral nor immoral, but non-moral.

This conclusion is thrust upon us by analogous facts in every part of the sentient world; yet, inasmuch as it not only jars upon prevalent prejudices, but arouses the natural dislike to that which is painful, much ingenuity has been exercised in devising an escape from it.

From the theological side, we are told that this is a state of probation, and that the seeming injustices and immoralities of Nature will be compensated by and by. But how this compensation is to be effected, in the case of the great majority of sentient things, is not clear. I apprehend that no one is seriously prepared to maintain that the ghosts of all the myriads of generations of herbivorous animals which lived during the millions of years of the earth's duration before the appearance of man, and which have all that time been tormented and devoured by carnivores, are to be compensated by a perennial existence in clover; while the ghosts of carnivores are to go to some kennel where there is neither a pan of water nor a bone with any meat on it. Besides, from the point of view of morality, the last state of things would be worse than the first. For the carnivores, however brutal and sanguinary, have only done that which, if there is any evidence of contrivance in the world, they were expressly constructed to do. Moreover, carnivores and herbivores alike have been subject to all the miseries incidental to old age, disease, and over-multiplication, and both might well put in a claim for "compensation" on this score.

On the evolutionist side, on the other hand, we are told to take comfort from the reflection that the terrible struggle for existence tends to final good, and that the suffering of the ancestor is paid for by the increased perfection of the progeny. There would be something in this argument if, in Chinese fashion, the present generation could pay its debts to its ancestors; otherwise, it is not clear what

compensation the *Eohippus* gets for his sorrows in the fact that, some millions of years afterward, one of his descendants wins the Derby. And, again, it is an error to imagine that evolution signifies a constant tendency to increased perfection. That process undoubtedly involves a constant readjustment of the organism in adaptation to new conditions; but it depends on the nature of those conditions whether the direction of the modifications effected shall be upward or downward. Retrogressive is as practicable as progressive metamorphosis. If what the physical philosophers tell us, that our globe has been in a state of fusion, and, like the sun, is gradually cooling down, is true, then the time must come when evolution will mean adaptation to a universal winter, and all forms of life will die out, except such low and simple organisms as the diatom of the arctic and antarctic ice and the protococcus of the red snow. If our globe is proceeding from a condition in which it was too hot to support any but the lowest living thing to a condition in which it will be too cold to permit of the existence of any others, the course of life upon its surface must describe a trajectory like that of a ball fired from a mortar; and the sinking half of that course is as much a part of the general process of evolution as the rising.

From the point of view of the moralist the animal world is on about the same level as a gladiator's show. The creatures are fairly well treated, and set to fight—whereby the strongest, the swiftest, and the cunningest live to fight another day. The spectator has no need to turn his thumbs down, as no quarter is given. He must admit that the skill and training displayed are wonderful; but he must shut his eyes if he would not see that more or less enduring suffering is the meed of both vanquished and victor. And since the great game is going on in every corner of the world, thousands of times a minute; since, were our ears sharp enough, we need not descend to the gates of hell to hear—

"sospiri, pianti, ed alti guai,*

. . . . . .

Voci alte e fioche, e suon di man con elle"—†

it seems to follow that, if this world is governed by benevolence, it must be a different sort of benevolence from that of John Howard.

But the old Babylonians wisely symbolized Nature by their great goddess Istar, who combined the attributes of Aphrodite with those of Ares. Her terrible aspect is not to be ignored or covered up with shams; but it is not the only one. If the optimism of Leibnitz is a foolish though pleasant dream, the pessimism of Schopenhauer is a nightmare, the more foolish because of its hideousness. Error which is not pleasant is surely the worst form of wrong.

This may not be the best of all possible worlds, but to say that it

* Sighs, plaints, and loud cries.

† Voices loud and weak, and with them sounds of blows.

is the worst is mere petulant nonsense. A worn-out voluptuary may find nothing good under the sun, or a vain and inexperienced youth, who can not get the moon he cries for, may vent his irritation in pessimistic moanings; but there can be no doubt in the mind of any reasonable person that mankind could, would, and in fact do, get on fairly well with vastly less happiness and far more misery than find their way into the lives of nine people out of ten. If each and all of us had been visited by an attack of neuralgia, or of extreme mental depression, for one hour in every twenty-four—a supposition which many tolerably vigorous people know, to their cost, is not extravagant—the burden of life would have been immensely increased without much practical hindrance to its general course. Men with any manhood in them find life quite worth living under worse conditions than these.

There is another sufficiently obvious fact which renders the hypothesis that the course of sentient Nature is dictated by malevolence quite untenable. A vast multitude of pleasures, and these among the purest and the best, are superfluities, bits of good which are to all appearance unnecessary as inducements to live, and are, so to speak, thrown into the bargain of life. To those who experience them, few delights can be more entrancing than such as are afforded by natural beauty or by the arts, and especially by music; but they are products of, rather than factors in, evolution, and it is probable that they are known, in any considerable degree, to but a very small proportion of mankind.

The conclusion of the whole matter seems to be that, if Ormuzd has not had his way in this world, neither has Ahriman. Pessimism is as little consonant with the facts of sentient existence as optimism. If we desire to represent the course of Nature in terms of human thought, and assume that it was intended to be that which it is, we must say that its governing principle is intellectual and not moral; that it is a materialized logical process accompanied by pleasures and pains, the incidence of which, in the majority of cases, has not the slightest reference to moral desert. That the rain falls alike upon the just and the unjust, and that those upon whom the Tower of Siloam fell were no worse than their neighbors, seem to be Oriental modes of expressing the same conclusion.

In the strict sense of the word "Nature," it denotes the sum of the phenomenal world, of that which has been, and is, and will be; and society, like art, is therefore a part of Nature. But it is convenient to distinguish those parts of Nature in which man plays the part of immediate cause, as something apart; and, therefore, society, like art, is usefully to be considered as distinct from Nature. It is the more desirable, and even necessary, to make this distinction, since society differs from Nature in having a definite moral object; whence it comes about that the course shaped by the ethical man—the member

of society or citizen—necessarily runs counter to that which the non-ethical man—the primitive savage, or man as a mere member of the animal kingdom—tends to adopt. The latter fights out the struggle for existence to the bitter end, like any other animal; the former devotes his best energies to the object of setting limits to the struggle.

In the cycle of phenomena presented by the life of man, the animal, no more moral end is discernible than in that presented by the lives of the wolf and of the deer. However imperfect the relics of prehistoric men may be, the evidence which they afford clearly tends to the conclusion that, for thousands and thousands of years, before the orgin of the oldest known civilizations, men were savages of a very low type. They strove with their enemies and their competitors; they preyed upon things weaker or less cunning than themselves; they were born, multiplied without stint, and died, for thousands of generations, alongside the mammoth, the urus, the lion, and the hyena, whose lives were spent in the same way; and they were no more to be praised or blamed, on moral grounds, than their less erect and more hairy compatriots.

As among these, so among primitive men, the weakest and stupidest went to the wall, while the toughest and shrewdest, those who were best fitted to cope with their circumstances, but not the best in any other sense, survived. Life was a continual free fight, and beyond the limited and temporary relations of the family, the Hobbesian war of each against all was the normal state of existence. The human species, like others, plashed and floundered amid the general stream of evolution, keeping its head above water as it best might, and thinking neither of whence nor whither.

The history of civilization—that is, of society—on the other hand, is the record of the attempts which the human race has made to escape from this position. The first men who substituted the state of mutual peace for that of mutual war, whatever the motive which impelled them to take that step, created society. But, in establishing peace, they obviously put a limit upon the struggle for existence. Between the members of that society, at any rate, it was not to be pursued *à outrance*. And of all the successive shapes which society has taken, that most nearly approaches perfection in which the war of individual against individual is most strictly limited. The primitive savage, tutored by Istar, appropriated whatever took his fancy, and killed whomsoever opposed him, if he could. On the contrary, the ideal of the ethical man is to limit his freedom of action to a sphere in which he does not interfere with the freedom of others; he seeks the common weal as much as his own; and, indeed, as an essential part of his own welfare. Peace is both end and means with him; and he founds his life on a more or less complete self-restraint, which is the negation of the struggle for existence. He tries to escape from his place in the animal kingdom, founded on the free development of the

principle of non-moral evolution, and to found a kingdom of Man, governed upon the principle of moral evolution. For society not only has a moral end, but in its perfection, social life, is embodied morality.

But the effort of ethical man to work toward a moral end by no means abolished, perhaps has hardly modified, the deep-seated organic impulses which impel the natural man to follow his non-moral course. One of the most essential conditions, if not the chief cause, of the struggle for existence, is the tendency to multiply without limit, which man shares with all living things. It is notable that "increase and multiply" is a commandment traditionally much older than the ten, and that it is, perhaps, the only one which has been spontaneously and *ex animo* obeyed by the great majority of the human race. But, in civilized society, the inevitable result of such obedience is the re-establishment, in all its intensity, of that struggle for existence—the war of each against all—the mitigation or abolition of which was the chief end of social organization.

It is conceivable that, at some period in the history of the fabled Atlantis, the production of food should have been exactly sufficient to meet the wants of the population, that the makers of artificial commodities should have amounted to just the number supportable by the surplus food of the agriculturists. And, as there is no harm in adding another monstrous supposition to the foregoing, let it be imagined that every man, woman, and child was perfectly virtuous, and aimed at the good of all as the highest personal good. In that happy land, the natural man would have been finally put down by the ethical man. There would have been no competition, but the industry of each would have been serviceable to all; nobody being vain and nobody avaricious, there would have been no rivalries; the struggle for existence would have been abolished, and the millennium would have finally set in. But it is obvious that this state of things could have been permanent only with a stationary population. Add ten fresh mouths; and as, by the supposition, there was only exactly enough before, somebody must go on short rations. The Atlantis society might have been a heaven upon earth, the whole nation might have consisted of just men, needing no repentance, and yet somebody must tarve. Reckless Istar, non-moral Nature, would have riven the social fabric. I was once talking with a very eminent physician about the *vis medicatrix naturæ*. "Stuff!" said he; "nine times out of ten Nature does not want to cure the man; she wants to put him in his coffin." And Istar-Nature appears to have equally little sympathy with the needs of society. "Stuff! she wants nothing but a fair field and free play for her darling the strongest."

Our Atlantis may be an impossible figment, but the antagonistic tendencies which the fable adumbrates have existed in every society which was ever established, and, to all appearance, must strive for the victory in all that will be. Historians point to the greed and ambi-

tion of rulers, to the reckless turbulence of the ruled, to the debasing effects of wealth and luxury, and to the devastating wars which have formed a great part of the occupation of mankind, as the causes of the decay of states and the foundering of old civilizations, and thereby point their story with a moral. No doubt immoral motives of all sorts have figured largely among the minor causes of these events. But, beneath all this superficial turmoil, lay the deep-seated impulse given by unlimited multiplication. In the swarms of colonies thrown out by Phœnicia and by old Greece; in the "ver sacrum" of the Latin races; in the floods of Gauls and of Teutons which burst over the frontiers of the old civilization of Europe; in the swaying to and fro of the vast Mongolian hordes in late times, the population problem comes to the front in a very visible shape. Nor is it less plainly manifest in the everlasting agrarian questions of ancient Rome than in the Arreoi societies of the Polynesian Islands.

In the ancient world and in a large part of that in which we now live, the practice of infanticide was or is a regular and legal custom; the steady recurrence of famine, pestilence, and war were and are normal factors in the struggle for existence, and have served, in a gross and brutal fashion, to mitigate the intensity of its chief cause.

But, in the more advanced civilizations, the progress of private and public morality has steadily tended to remove all these checks. We declare infanticide murder, and punish it as such; we decree, not quite successfully, that no one shall die of hunger; we regard death from preventable causes of other kinds as a sort of constructive murder, and eliminate pestilence to the best of our ability; we declaim against the curse of war and the wickedness of the military spirit, and we are never weary of dilating on the blessedness of peace and the innocent beneficence of industry. In their moments of expansion, even statesmen and men of business go thus far. The finer spirits look to an ideal "civitas Dei"; a state when, every man having reached the point of absolute self-negation, and having nothing but moral perfection to strive after, peace will truly reign, not merely among nations, but among men, and the struggle for existence will be at an end.

Whether human nature is competent, under any circumstances, to reach, or even seriously advance toward, this ideal condition, is a question which need not be discussed. It will be admitted that mankind has not yet reached this stage by a very long way, and my business is with the present. And that which I wish to point out is that, so long as the natural man increases and multiplies without restraint, so long will peace and industry not only permit, but they will necessitate, a struggle for existence as sharp as any that ever went on under the *régime* of war. If Istar is to reign on the one hand, she will demand her human sacrifices on the other.

Let us look at home. For seventy years, peace and industry have

had their way among us with less interruption and under more favorable conditions than in any other country on the face of the earth. The wealth of Crœsus was nothing to that which we have accumulated, and our prosperity has filled the world with envy. But Nemesis did not forget Crœsus; has she forgotten us?

I think not. There are now thirty-six millions of people in our island, and every year considerably more than three hundred thousand are added to our numbers.* That is to say, about every hundred seconds, or so, a new claimant to a share in the common stock of maintenance presents him or herself among us. At the present time, the produce of the soil does not suffice to feed half its population. The other moiety has to be supplied with food which must be bought from the people of food-producing countries. That is to say, we have to offer them the things which they want in exchange for the things we want. And the things they want and which we can produce better than they can are mainly manufactures—industrial products.

The insolent reproach of the first Napoleon had a very solid foundation. We not only are, but, under penalty of starvation, we are bound to be, a nation of shopkeepers. But other nations also lie under the same necessity of keeping shop, and some of them deal in the same goods as ourselves. Our customers naturally seek to get the most and the best in exchange for their produce. If our goods are inferior to those of our competitors, there is no ground compatible with the sanity of the buyers, which can be alleged, why they should not prefer the latter. And, if that result should ever take place on a large and general scale, five or six millions of us would soon have nothing to eat. We know what the cotton famine was; and we can therefore form some notion of what a dearth of customers would be.

Judged by an ethical standard, nothing can be less satisfactory than the position in which we find ourselves. In a real, though incomplete, degree we have attained the condition of peace which is the main object of social organization; and it may, for argument's sake, be assumed that we desire nothing but that which is in itself innocent and praiseworthy—namely, the enjoyment of the fruits of honest industry. And lo! in spite of ourselves, we are in reality engaged in an internecine struggle for existence with our presumably no less peaceful and well-meaning neighbors. We seek peace and we do not ensue it. The moral nature in us asks for no more than is compatible with the general good; the non-moral nature proclaims and acts upon that fine old Scottish family motto, "Thou shalt starve ere I want." Let us be under no illusions, then. So long as unlimited multiplication goes on, no social organization which has ever been devised, or is

* These numbers are only approximately accurate. In 1881 our population amounted to 35,241,482, exceeding the number in 1871 by 3,396,103. The average annual increase in the decennial period 1871–1881 is therefore 339,610. The number of minutes in a calendar year is 525,600.

likely to be devised; no fiddle-faddling with the distribution of wealth, will deliver society from the tendency to be destroyed by the reproduction within itself, in its intensest form, of that struggle for existence, the limitation of which is the object of society. And however shocking to the moral sense this eternal competition of man against man and of nation against nation may be; however revolting may be the accumulation of misery at the negative pole of society, in contrast with that of monstrous wealth at the positive pole; this state of things must abide, and grow continually worse, so long as Istar holds her way unchecked. It is the true riddle of the Sphinx; and every nation which does not solve it will sooner or later be devoured by the monster itself has generated.

The practical and pressing question for us just now seems to me to be how to gain time. "Time brings counsel," as the Teutonic proverb has it; and wiser folk among our posterity may see their way out of that which at present looks like an *impasse*.

It would be folly to entertain any ill-feeling toward those neighbors and rivals who, like ourselves, are slaves of Istar; but, if somebody is to be starved, the modern world has no Oracle of Delphi to which the nations can appeal for an indication of the victim. It is open to us to try our fortune; and if we avoid impending fate, there will be a certain ground for believing that we are the right people to escape. *Securus judicat orbis.*

To this end, it is well to look into the necessary conditions of our salvation by works. They are two, one plain to all the world and hardly needing insistence; the other seemingly not so plain, since too often it has been theoretically and practically left out of sight. The obvious condition is that our produce shall be better than that of others. There is only one reason why our goods should be preferred to those of our rivals—our customers must find them better at the price. That means that we must use more knowledge, skill, and industry in producing them, without a proportionate increase in the cost of production; and, as the price of labor constitutes a large element in that cost, the rate of wages must be restricted within certain limits. It is perfectly true that cheap production and cheap labor are by no means synonymous; but it is also true that wages can not increase beyond a certain proportion without destroying cheapness. Cheapness, then, with, as part and parcel of cheapness, a moderate price of labor, is essential to our success as competitors in the markets of the world.

The second condition is really quite as plainly indispensable as the first, if one thinks seriously about the matter. It is social stability. Society is stable when the wants of its members obtain as much satisfaction as, life being what it is, common sense and experience show may be reasonably expected. Mankind, in general, care very little

for forms of government or ideal considerations of any sort; and nothing really stirs the great multitude of mankind to break with custom and incur the manifest perils of revolt except the belief that misery in this world or damnation in the next, or both, are threatened by the continuance of the state of things in which they have been brought up. But when they do attain that conviction, society becomes as unstable as a package of dynamite, and a very small matter will produce the explosion which sends it back to the chaos of savagery.

It needs no argument to prove that, when the price of labor sinks below a certain point, the worker infallibly falls into that condition which the French emphatically call *la misère*—a word for which I do not think there is any exact English equivalent. It is a condition in which the food, warmth, and clothing which are necessary for the mere maintenance of the functions of the body in their normal state can not be obtained; in which men, women, and children are forced to crowd into dens wherein decency is abolished and the most ordinary conditions of healthful existence are impossible of attainment; in which the pleasures within reach are reduced to bestiality and drunkenness; in which the pains accumulate at compound interest, in the shape of starvation, disease, stunted development, and moral degradation; in which the prospect of even steady and honest industry is a life of unsuccessful battling with hunger, rounded by a pauper's grave.

That a certain proportion of the members of every great aggregation of mankind should constantly tend to establish and populate such a *Malebolge* as this is inevitable, so long as some people are by nature idle and vicious, while others are disabled by sickness or accident, or thrown upon the world by the death of their bread-winners. So long as that proportion is restricted within tolerable limits, it can be dealt with; and, so far as it arises only from such causes, its existence may and must be patiently borne. But, when the organization of society, instead of mitigating this tendency, tends to continue and intensify it; when a given social order plainly makes for evil and not for good, men naturally enough begin to think it high time to try a fresh experiment. The animal man, finding that the ethical man has landed him in such a slough, resumes his ancient sovereignty and preaches anarchy; which is, substantially, a proposal to reduce the social cosmos to chaos and begin the brute struggle for existence once again.

Any one who is acquainted with the state of the population of all great industrial centers, whether in this or other countries, is aware that, amid a large and increasing body of that population, *la misère* reigns supreme. I have no pretensions to the character of a philanthropist, and I have a special horror of all sorts of sentimental rhetoric; I am merely trying to deal with facts, to some extent within my own knowledge, and further evidenced by abundant testimony, as a naturalist; and I take it to be a mere plain truth that, throughout indus-

trial Europe, there is not a single large manufacturing city which is free from a vast mass of people whose condition is exactly that described, and from a still greater mass who, living just on the edge of the social swamp, are liable to be precipitated into it by any lack of demand for their produce. And, with every addition to the population, the multitude already sunk in the pit and the number of the host sliding toward it continually increase.

Argumentation can hardly be needful to make it clear that no society in which the elements of decomposition are thus swiftly and surely accumulating can hope to win in the race of industries.

Intelligence, knowledge, and skill are undoubtedly conditions of success; but of what avail are they likely to be unless they are backed up by honesty, energy, good-will, and all the physical and moral faculties that go to the making of manhood, and unless they are stimulated by hope of such reward as men may fairly look to? And what dweller in the slough of *misère*, dwarfed in body and soul, demoralized, hopeless, can reasonably be expected to possess these qualities?

Any full and permanent development of the productive powers of an industrial population, then, must be compatible with, and, indeed, based upon a social organization which will secure a fair amount of physical and moral welfare to that population; which will make for good and not for evil. Natural science and religious enthusiasm rarely go hand in hand, but on this matter their concord is complete; and the least sympathetic of naturalists can but admire the insight and the devotion of such social reformers as the late Lord Shaftesbury, whose recently published "Life and Letters" gives a vivid picture of the condition of the working classes fifty years ago, and of the pit which our industry, ignoring these plain truths, was then digging under its own feet.

There is perhaps no more hopeful sign of progress among us in the last half-century than the steadily increasing devotion which has been and is directed to measures for promoting physical and moral welfare among the poorer classes. Sanitary reformers, like most other reformers whom I have had the advantage of knowing, seem to need a good dose of fanaticism, as a sort of moral coca, to keep them up to the mark, and, doubtless, they have made many mistakes; but that the endeavor to improve the condition under which our industrial population live, to amend the drainage of densely peopled streets, to provide baths, wash-houses, and gymnasia, to facilitate habits of thrift, to furnish some provision for instruction and amusement in public libraries and the like, is not only desirable from a philanthropic point of view, but an essential condition of safe industrial development, appears to me to be indisputable. It is by such means alone, so far as I can see, that we can hope to check the constant gravitation of industrial society toward *la misère*, until the general progress of intelligence and morality leads men to grapple with the sources of that tendency. If

it is said that the carrying out of such arrangements as those indicated must enhance the cost of production, and thus handicap the producer in the race of competition, I venture, in the first place, to doubt the fact; but if it be so, it results that industrial society has to face a dilemma, either horn of which threatens impalement.

On the one hand, a population whose labor is sufficiently remunerated may be physically and morally healthy and socially stable, but may fail in industrial competition by reason of the dearness of its produce. On the other hand, a population whose labor is insufficiently remunerated must become physically and morally unhealthy, and socially unstable; and though it may succeed for a while in industrial competition, by reason of the cheapness of its produce, it must in the end fall, through hideous misery and degradation, to utter ruin.

Well, if these are the only possible alternatives, let us for ourselves and our children choose the former, and, if need be, starve like men. But I do not believe that a stable society made up of healthy, vigorous, instructed, and self-ruling people would ever incur serious risk of that fate. They are not likely to be troubled with many competitors of the same character, and they may be safely trusted to find ways of holding their own.

Assuming that the physical and moral well-being and the stable social order, which are the indispensable conditions of permanent industrial development, are secured, there remains for consideration the means of attaining that knowledge and skill, without which, even then, the battle of competition can not be successfully fought. Let us consider how we stand. A vast system of elementary education has now been in operation among us for sixteen years, and has reached all but a very small fraction of the population. I do not think that there is any room for doubt that, on the whole, it has worked well, and that its indirect no less than its direct benefits have been immense. But, as might be expected, it exhibits the defects of all our educational systems—fashioned as they were to meet the wants of a by-gone condition of society. There is a wides-pread, and I think well-justified, complaint that it has too much to do with books and too little to do with things. I am as little disposed as any one can well be to narrow early education and to make the primary school a mere annex of the shop. And it is not so much in the interests of industry as in that of breadth of culture, that I echo the common complaint against the bookish and theoretical character of our primary instruction.

If there were no such things as industrial pursuits, a system of education which does nothing for the faculties of observation, which trains neither the eye nor the hand, and is compatible with utter ignorance of the commonest natural truths, might still be reasonably regarded as strangely imperfect. And when we consider that the instruction and training which are lacking are exactly those which are

of most importance for the great mass of our population, the fault becomes almost a crime, the more that there is no practical difficulty in making good these defects. There really is no reason why drawing should not be universally taught, and it is an admirable training for both eye and hand. Artists are born, not made; but everybody may be taught to draw elevations, plans, and sections; and pots and pans are as good, indeed better, models for this purpose than the Apollo Belvedere. The plant is not expensive; and there is this excellent quality about drawing of the kind indicated, that it can be tested almost as easily and severely as arithmetic. Such drawings are either right or wrong, and if they are wrong the pupil can be made to see that they are wrong. From the industrial point of view, drawing has the further merit that there is hardly any trade in which the power of drawing is not of daily and hourly utility. In the next place, no good reason, except the want of capable teachers, can be assigned why elementary notions of science should not be an element in general instruction. In this case, again, no experience or elaborate apparatus is necessary. The commonest thing—a candle, a boy's squirt, a piece of chalk—in the hands of a teacher who knows his business may be made the starting-points whence children may be led into the regions of science as far as their capacity permits, with efficient exercise of their observational and reasoning faculties on the road. If object-lessons often prove trivial failures, it is not the fault of object-lessons, but that of the teacher, who has not found out how much the power of teaching a little depends on knowing a great deal, and that thoroughly; and that he has not made that discovery is not the fault of the teachers, but of the detestable system of training them which is widely prevalent.*

As I have said, I do not regard the proposal to add these to the present subjects of universal instruction, as made merely in the interests of industry. Elementary science and drawing are just as needful at Eton (where I am happy to say both are now parts of the regular course) as in the lowest primary school. But their importance in the education of the artisan is enhanced, not merely by the fact that the knowledge and skill thus gained—little as they may amount to—will still be of practical utility to him; but further, because they constitute an introduction to that special training which is commonly called "technical education."

I conceive that our wants in this last direction may be grouped under four heads: (1) Instruction in the principles of those branches of science and of art which are peculiarly applicable to industrial pursuits, which may be called preliminary scientific education. (2) In-

* Training in the use of simple tools is no doubt very desirable, on all grounds. From the point of view of "culture," the man whose "fingers are all thumbs" is but a stunted creature. But the practical difficulties in the way of introducing handiwork of this kind into elementary schools appear to me to be considerable.

struction in the special branches of such applied science and art, as technical education proper. (3) Instruction of teachers in both these branches. (4) Capacity-catching machinery.

A great deal has already been done in each of these directions, but much remains to be done. If elementary education is amended in the way that has been suggested, I think that the school-boards will have quite as much on their hands as they are capable of doing well. The influences under which the members of these bodies are elected do not tend to secure fitness for dealing with scientific or technical education; and it is the less necessary to burden them with an uncongenial task as there are other organizations, not only much better fitted to do the work, but already actually doing it.

In the matter of preliminary scientific education, the chief of these is the Science and Art Department, which has done more during the last quarter of a century for the teaching of elementary science among the masses of the people than any organization which exists either in this or in any other country. It has become veritably a people's university, so far as physical science is concerned. At the foundation of our old universities they were freely open to the poorest, but the poorest must come to them. In the last quarter of a century, the Science and Art Department, by means of its classes spread all over the country and open to all, has conveyed instruction to the poorest. The University Extension movement shows that our older learned corporations have discovered the propriety of following suit.

Technical education, in the strict sense, has become a necessity for two reasons. The old apprenticeship system has broken down, partly by reason of the changed conditions of industrial life, and partly because trades have ceased to be "crafts," the traditional secrets whereof the master handed down to his apprentices. Invention is constantly changing the face of our industries, so that "use and wont," "rule of thumb," and the like, are gradually losing their importance, while that knowledge of principles which alone can deal successfully with changed conditions is becoming more and more valuable. Socially, the "master" of four or five apprentices is disappearing in favor of the "employer" of forty, or four hundred, or four thousand "hands," and the odds and ends of technical knowledge, formerly picked up in a shop, are not, and can not be, supplied in the factory. The instruction formerly given by the master must therefore be more than replaced by the systematic teaching of the technical school.

Institutions of this kind on varying scales of magnitude and completeness, from the splendid edifice set up by the City and Guilds Institute to the smallest local technical school, to say nothing of classes, such as those in technology instituted by the Society of Arts (subsequently taken over by the City Guilds), have been established in various parts of the country, and the movement in favor of their increase and multiplication is rapidly growing in breadth and intensity. But

there is much difference of opinion as to the best way in which the technical instruction, so generally desired, should be given. Two courses appear to be practicable: the one is the establishment of special technical schools with a systematic and lengthened course of instruction demanding the employment of the whole time of the pupils. The other is the setting afoot of technical classes, especially evening classes, comprising a short series of lessons on some special topic, which may be attended by persons already earning wages in some branch of trade or commerce.

There is no doubt that technical schools, on the plan indicated under the first head, are extremely costly; and, so far as the teaching of artisans is concerned, it is very commonly objected to them that, as the learners do not work under trade conditions, they are apt to fall into amateurish habits, which prove of more hindrance than service in the actual business of life. When such schools are attached to factories under the direction of an employer who desires to train up a supply of intelligent workmen, of course this objection does not apply; nor can the usefulness of such schools for the training of future employers and for the higher grade of the employed be doubtful; but they are clearly out of the reach of the great mass of the people, who have to earn their bread as soon as possible. We must therefore look to the classes, and especially to the evening classes, as the great instrument for the technical education of the artisan. The utility of such classes has now been placed beyond all doubt; the only question which remains is to find the ways and means of extending them.

We are here, as in all other questions of social organization, met by two diametrically opposed views. On the one hand, the methods pursued in foreign countries are held up as our example. The state is exhorted to take the matter in hand, and establish a great system of technical education. On the other hand, many economists of the individualist school exhaust the resources of language in condemning and repudiating, not merely the interference of the general government in such matters, but the application of a farthing of the funds raised by local taxation to these purposes. I entertain a strong conviction that, in this country, at any rate, the state had much better leave purely technical and trade instruction alone. But, although my personal leanings are decidedly toward the individualists, I have arrived at that conclusion on merely practical grounds. In fact, my individualism is rather of a sentimental sort, and I sometimes think I should be stronger in the faith if it were less vehemently advocated.* I am unable to see that civil society is anything but a corporation established for a moral object—namely, the good of its members—

* In what follows I am only repeating and emphasizing opinions which I expressed, seventeen years ago, in an address to the members of the Midland Institute (republished in "Critiques and Addresses" in 1873). I have seen no reason to modify them, notwithstanding high authority on the other side.

and therefore that it may take such measures as seem fitting for the attainment of that which the general voice decides to be the general good. That the suffrage of the majority is by no means a scientific test of social good and evil is unfortunately too true; but, in practice, it is the only test we can apply, and the refusal to abide by it means anarchy. The purest despotism that ever existed is as much based upon that will of the majority (which is usually submission to the will of a small minority) as the freest republic. Law is the expression of the opinion of the majority, and it is law, and not mere opinion, because the many are strong enough to enforce it.

I am as strongly convinced as the most pronounced individualist can be, that it is desirable that every man should be free to act in every way which does not limit the corresponding freedom of his fellow-man. But I fail to connect that great induction of sociology with the practical corollary which is frequently drawn from it; that the state—that is, the people in its corporate capacity—has no business to meddle with anything but the administration of justice and external defense.

It appears to me that the amount of freedom which incorporate society may fitly leave to its members is not a fixed quantity, to be determined *a priori* by deduction from the fiction called "natural rights"; but that it must be determined by, and vary with, circumstances.

I conceive it to be demonstrable that the higher and the more complex the organization of the social body, the more closely is the life of each member bound up with that of the whole; and the larger becomes the category of acts which cease to be merely self-regarding, and which interfere with the freedom of others more or less seriously.

If a squatter, living ten miles away from any neighbor, chooses to burn his house down to get rid of vermin, there may be no necessity (in the absence of insurance-offices) that the law should interfere with his freedom of action. His act can hurt nobody but himself; but if the dweller in a street chooses to do the same thing, the state very properly makes such a proceeding a crime, and punishes it as such. He does meddle with his neighbor's freedom, and that seriously. So it might, perhaps, be a tenable doctrine that it would be needless, and even tyrannous, to make education compulsory in a sparse agricultural population, living in abundance on the produce of its own soil; but, in a densely populated manufacturing country, struggling for existence with competitors, every ignorant person tends to become a burden upon, and, so far, an infringer of the liberty of, his fellows, and an obstacle to their success.

Under such circumstances an education rate is, in fact, a war-tax, levied for purposes of defense.

That state action always has been more or less misdirected, and always will be so, is, I believe, perfectly true. But I am not aware

that it is more true of the action of men in their corporate capacity than it is of the doings of individuals. The wisest and most dispassionate man in existence, merely wishing to go from one stile in a field to the opposite, will not walk quite straight—he is always going a little wrong, and always correcting himself; and I can only congratulate the individualist who is able to say that his general course of life has been of a less undulating character. To abolish state action, because its direction is never more than approximately correct, appears to me to be much the same thing as abolishing the man at the wheel altogether, because, do what he will, the ship yaws more or less. "Why should I be robbed of my property to pay for teaching another man's children?" is an individualist question, which is not unfrequently put as if it settled the whole business. Perhaps it does, but I find difficulties in seeing why it should. The parish in which I live makes me pay my share for the paving and lighting of a great many streets that I never pass through; and I might plead that I am robbed to smooth the way and lighten the darkness of other people. But I am afraid the parochial authorities would not let me off on this plea; and I must confess I do not see why they should.

I can not speak of my own knowledge, but I have every reason to believe that I came into this world a small reddish person, certainly without a gold spoon in my mouth, and in fact with no discernible abstract or concrete "rights" or property of any description. If a foot was not, at once, set upon me as a squalling nuisance, it was either the natural affection of those about me, which I certainly had done nothing to deserve, or the fear of the law which, ages before my birth, was painfully built up by the society into which I intruded, that prevented that catastrophe. If I was nourished, cared for, taught, saved from the vagabondage of a wastrel, I certainly am not aware that I did anything to deserve those advantages. And, if I possess anything now, it strikes me that, though I may have fairly earned my day's wages for my day's work, and may justly call them my property—yet, without that organization of society, created out of the toil and blood of long generations before my time, I should probably have had nothing but a flint axe and an indifferent hut to call my own; and even those would be mine only so long as no stronger savage came my way.

So that if society, having—quite gratuitously—done all these things for me, asks me in turn to do something toward its preservation—even if that something is to contribute to the teaching of other men's children—I really, in spite of all my individualist leanings, feel rather ashamed to say no. And if I were not ashamed, I can not say that I think that society would be dealing unjustly with me in converting the moral obligation into a legal one. There is a manifest unfairness in letting all the burden be borne by the willing horse.

It does not appear to me, then, that there is any valid objection to taxation for purposes of education; but, in the case of technical

schools and classes, I think it is practically expedient that such taxation should be local. Our industrial population accumulates in particular towns and districts; these districts are those which immediately profit by technical education; and it is only in them that we can find the men practically engaged in industries, among whom some may reasonably be expected to be competent judges of that which is wanted, and of the best means of meeting the want.

In my belief, all methods of technical training are at present tentative, and, to be successful, each must be adapted to the special peculiarities of its locality. This is a case in which we want twenty years; not of "strong government," but of cheerful and hopeful blundering; and we may be thankful if we get things straight in that time.

The principle of the bill introduced, but dropped, by the Government last session, appears to me to be wise, and some of the objections to it I think are due to a misunderstanding. The bill proposed in substance to allow localities to tax themselves for purposes of technical education—on the condition that any scheme for such purpose should be submitted to the Science and Art Department, and declared by that department to be in accordance with the intention of the legislature.

A cry was raised that the bill proposed to throw technical education into the hands of the Science and Art Department. But, in reality, no power of initiation, nor even of meddling with details, was given to that department—the sole function of which was to decide whether any plan proposed did or did not come within the limits of "technical education." The necessity for such control, somewhere, is obvious. No legislature, certainly not ours, is likely to grant the power of self-taxation without setting limits to that power in some way; and it would neither have been practicable to devise a legal definition of technical education, nor commendable to leave the question to the Auditor-General to be fought out in the law courts. The only alternative was to leave the decision to an appropriate state authority. If it is asked, What is the need of such control if the people of the localities are the best judges? the obvious reply is that there are localities and localities, and that while Manchester, or Liverpool, or Birmingham, or Glasgow, might, perhaps, be safely left to do as they thought fit, smaller towns, in which there is less certainty of full discussion by competent people of different ways of thinking, might easily fall a prey to crotcheteers.

Supposing our intermediate science-teaching and our technical schools and classes are established, there is yet a third need to be supplied, and that is the want of good teachers. And it is necessary not only to get them, but to keep them when you have got them.

It is impossible to insist too strongly upon the fact that efficient teachers of science and of technology are not to be made by the processes in vogue at ordinary training colleges. The memory loaded with mere book-work is not the thing wanted—is, in fact, rather worse

than useless—in the teacher of scientific subjects. It is absolutely essential that his mind should be full of knowledge and not of mere learning, and that what he knows should have been learned in the laboratory rather than in the library. There are happily already, both in London and in the provinces, various places in which such training is to be had, and the main thing at present is to make it in the first place accessible, and in the next indispensable, to those who undertake the business of teaching. But when the well-trained men are supplied, it must be recollected that the profession of teacher is not a very lucrative or otherwise tempting one, and that it may be advisable to offer special inducements to good men to remain in it. These, however, are questions of detail into which it is unnecessary to enter further.

Last, but not least, comes the question of providing the machinery for enabling those who are by nature specially qualified to undertake the higher branches of industrial work, to reach the position in which they may render that service to the community. If all our educational expenditure did nothing but pick one man of scientific or inventive genius, each year, from amid the hewers of wood and drawers of water, and give him the chance of making the best of his inborn faculties, it would be a very good investment. If there is one such child among the hundreds of thousands of our annual increase, it would be worth any money to drag him either from the slough of misery or from the hot-bed of wealth, and teach him to devote himself to the service of his people. Here, again, we have made a beginning with our scholarships and the like, and need only follow in the tracks already worn.

The programme of industrial development briefly set forth in the preceding pages is not what Kant calls a "Hirngespinnst," a cobweb spun in the brain of a Utopian philosopher. More or less of it has taken bodily shape in many parts of the country, and there are towns of no great size or wealth in the manufacturing districts (Keighley, for example) in which almost the whole of it has, for some time, been carried out so far as the means at the disposal of the energetic and public-spirited men who have taken the matter in hand, permitted. The thing can be done; I have endeavored to show good grounds for the belief that it must be done, and that speedily, if we wish to hold our own in the war of industry. I doubt not that it will be done, whenever its absolute necessity becomes as apparent to all those who are absorbed in the actual business of industrial life as it is to some of the lookers-on.—*Nineteenth Century.*

THE Bishop of Manchester remarked, in a sermon, during the meeting of the British Association in that city, that science had led Christians to discover how very gravely the New Testament had been misrepresented by the popular Christianity, and it had revolutionized the study of the Word of God.

FORMS AND FAILURES OF THE LAW.

By PHILIP SNYDER.

THE law's delay has long been a theme for comment, gibe, criticism, and denunciation. Even lawyers and judges discuss it occasionally, in published papers and orations at bar association meetings, but with no radical results. The abuse goes on, and doubtless will until those who suffer from it, the people, take the matter in their own hands and move for redress. They are thoroughly satisfied as to its necessity, but what is most wanted is leadership. Able and unselfish lawyers, if such can be found for it, would here find a promising field for honorable fame. But if there are none to volunteer, the reform will go on without them, and will not stop with the law's delays alone, which are trifling in comparison with the work that needs to be done.

Judge William L. Learned, of the New York State Supreme Court, in a paper on "The Law's Delays," makes an admission of striking significance. He says: "In most things we move more rapidly than former generations did. We travel faster; we send messages across the ocean in a few minutes; we transact business of large amounts in a short time; but when we come to our litigations we find the reproach of the law's delays still existing. We have done very little to remedy this great wrong; indeed, it is doubtful whether in this matter we have not gone backward. Lords Kenyon and Ellenborough tried cases at the rate of twenty-five a day. The very last day that Lord Ellenborough sat at Guildhall, when he was laboring under great infirmity and weakness, he tried seventeen defended cases." A trial now of seventeen cases a day, even by an able-bodied judge, would probably alarm the bar and result in an early retirement of the judge (if holding place by election), for the reason that his dispatch of business would lessen the emoluments of the lawyers. But the main concession is that while there is advancement in every other field of human effort, in law alone are we at a standstill, or are retrograding! A few creditable changes in procedures have been introduced after prolonged and tedious opposition, such as that an accused party may testify in his own behalf, or that a wife may testify for or against her husband; but in the main we have the same forms and ceremonies that came into use five centuries or more ago, the same mass of verbiage in legal forms that confuse and perplex, and convey no idea of anything in particular except vacuity. Let a man of ordinary intelligence read a formal indictment for murder, and then ask him to tell what are the ideas expressed, and he can hardly do it with more clearness than if written in Greek or Chaldaic. Take the concluding paragraph of a warranty deed in common use, and we have one hundred and sixty-two words of idiotic verbiage that not one man in a hundred can un-

derstand except by hard study and risk of brain-fever, and even lawyers, judges, and conveyancers must judge of it by its conformity to prescribed legal forms rather than through any warrant of title conveyed by it. But though every man not a lawyer abhors such a jumble of words, it remains as part of the machinery by which real estate is transferred, and any proposition in a State Legislature to abolish such a form and substitute something clear, short, and explicit, would call out the active opposition of not only every lawyer in the body—which is usually two thirds of all the members—but also of, substantially, every lawyer and court officer in the State, as well as every legal printer and dealer in legal stationery, for the reason urged by Demetrius in Acts xix, 25, "By this craft we have our wealth." And *this* evidently is the one controlling, all-powerful influence which stands in the way of legal reforms, and will until the people combine and overthrow it.

It is not the law's delays, then, which by any means constitute its one great offense. That is but an incident of a system which needs reform from top to bottom. The lawyer has, seemingly, settled down to the conviction that his "best hold" for a fortune is to oppose radical changes, at least until some substitute as profitable is within reach. He may not be opposed to reforms in the abstract, but a reform that is to cost perhaps thousands a year at first, though it may be of immense benefit to clients, is not to his liking. That is his conservatism. Perhaps morally it is not unlike that of others whose vocations have been abolished through great modern inventions—the use of steam, electricity, etc.—but if so, the peculiar tactics of the legal fraternity have defeated nearly all propositions for legal reforms, and thus justified the statement of Judge Learned already quoted. The lawyers forget that in other callings nothing has been lost in the aggregate to anybody by reforms that facilitate business, as new inventions create new industries requiring a higher grade of intelligence; and that business is always sure to develop in proportion to the facilities for its rapid, safe, and cheap dispatch. None smile sooner than they at the occasional outbreaks, even yet, of ignorant laborers against new inventions, on the ground that such changes drive them to starvation. They know, if laborers do not, that machinery only changes the form and method of industry without abolishing it, and hence it would be well to consider if this principle would not apply also to a reformed system of law procedure which would secure justice speedily instead of defeating it through delays that extend through generations, with little benefit to anybody but lawyers. It certainly prejudices the community against the legal profession, and impels many tempted into litigation to keep aloof, and often to bear their wrongs at great loss rather than risk further losses by employing lawyers who have no interest in any case except to extract fees or reputations from it. But if we had

a system of deciding law questions speedily and cheaply it might lead to a greater volume of business, promote the ends of justice far better, and elevate the profession immeasurably in public esteem. Even if the reforms would dispense with one half or two thirds of all the lawyers, and who may be said to be non-producers of public wealth, it would not be a reform that really high-minded and conscientious lawyers need regret. A country like ours should not tolerate any parasitic classes; and, once rid of all the useless lawyers, the reform would make some other classes useful whose presence now is detrimental to the public good.

Let us look at some of the changes for which public sentiment seems ready, and which would certainly be inaugurated soon if a liberal-minded bench and the more honorable members of the bar were to sanction them. They are noted here, not so much in the order of their importance, as in the order in which they come to mind.

First, the jury system. There is wide-spread dissatisfaction with it, especially as to capital cases, or where heavy punishment is involved. In important civil cases where great interests are at stake, it is also regarded very much as a failure, leading nearly as often to the miscarriage of justice as otherwise. The traditions that require unanimous verdicts are antiquated and unworthy of serious consideration. Why should twelve men, totally untrained in the examination of legal questions or evidence, be expected to agree, in the face of a mass of contradictory evidence, and after listening for hours, or even days and weeks, to the arguments of counsel skilled in making the worse appear the better reasoning, and without a scrap of written or printed testimony before them? Two witnesses to the same transaction can rarely agree as to details, and yet a jury of twelve men, some of them very ignorant, are required to agree, or else the case, in all its dreary length and breadth, must be tried again before twelve other men equally unfit, or be abandoned. If they do not agree on the first ballot, they are kept in confinement until the strongest-willed can conquer the rest, or until their natural desire for a discharge impels them to agree, whether the verdict represents their real convictions or not. It is right that, in capital cases at least, there should be a heavy preponderance, but to require unanimity is absurd, and often defeats justice. If eight or nine men out of twelve can agree that a prisoner is guilty, it should be sufficient, especially while all the chances for appeals and pardons remain. Were the verdict a finality, it would be different; but no convicted murderer with money at his command ever thinks of submitting at once to an adverse verdict. The criminal laws seem specially contrived to shield notorious villains from swift punishment; and the "able counsel," no matter what his case, keeps up the fight until every resource for delay or escape is exhausted.

The one vicious principle at the base of litigation, at least in criminal cases, and which overshadows all others, is that the professional advocate is generally oblivious to all the claims of abstract justice, or that there is any obligation resting on him to protect the community. It is his *client* who is to be sustained, right or wrong, and the claims of justice or of the public receive no consideration. He is educated to this idea in the law-school, and, becoming a rule of action, it makes the lawyer, comparatively, a narrow man, and one of the most unfit of all men—of equal education—to trust on questions involving the great interests of society, hence especially unfit to be a law-*maker*. This allegation will surprise some, but it need not when we remember that it is quite as much the lawyer's business to impair or destroy the force of a good law as to sustain it. He labors to find defects in the law, or to boldly mislead courts and juries so as to secure wrong interpretations of law, and thus by assurance and false logic screening his client against its just intent. To make legislators out of such men is poor policy, because ill-digested, obscure, contradictory statutes grind out grists for the lawyers' mills, and the man educated to look out for nobody but himself is reasonably sure not to neglect such an opportunity to promote litigation.

This disposition to thwart justice on occasion suggests another reform. If judges are really "learned in the law," as they should be, why are lawyers needed at all as advocates *pro* or *con* in the trial of ordinary jury cases? Why not make it the business of the judge to examine the witnesses and bring out all the facts? It is the facts as they bear on the case which are wanted, and not that version of them which the paid advocates wish presented. They have no wish and no intention to bring out the truth except as it assists their own side; they desire, indeed, to suppress it when possible, which is their aim in the bullying and browbeating of timid witnesses: hence the judge, who is sworn to impartiality, and has no interest in concealing anything, is a far better man to examine the witnesses. If this would overwork him, let him have assistants, or let the court be composed of several judges. The taking of testimony would then be more rapid, because there would be no lawyers' wordy wrangles to cause delay and weary the jury; and, when concluded, the presiding judge would not, in making his charge, be obliged to warn the jury against a mass of irrelevant testimony. In order to guard against possible errors by the court and secure a review by a higher court on really important points, counsel for each side might be present to watch, take exceptions, and secure a review under certain limitations; but a careful judge would rarely make mistakes that needed review. Besides, appeals or reviews should be greatly limited. Judge Learned, in his article, shows their abuse and evils very clearly, and also points out that they do little toward securing exact justice. "When the end is reached," he says, "it is an end only because it can go no further, and

not that the last of a dozen or twenty trials is infallible." The long delays, extending sometimes through several generations, do more to impede justice and bring odium on law and lawyer than any right decision at the final end can neutralize. It has become, in the main, a contest of the longest purse, and that even-handed justice should suppress. And this would have happened long ago but for the lawyers.

The requirements of present laws which authorize the exclusion from juries of persons who may have formed an opinion of the case from newspaper reports is another absurdity. Few well-balanced men would be influenced in a verdict by what they had read or heard before the trial. In some cases it would assist them in the examination of witnesses, for that should be part of the duty of every intelligent juror. What is wanted of a juryman is not original ignorance of the case, but that cast of mind to give a verdict on the evidence presented on the trial—not as presented in the newspapers. To do otherwise is to restrict the choice of jurors to the most ignorant men instead of the most intelligent, and to that are undoubtedly due the many monstrous verdicts which disgrace our jurisprudence. Men who do not think, or read, or study, are exactly the sort of men to be led astray by glib-tongued lawyers, and made to forget the evidence and even to disregard the judge's cool analysis of it. It is difficult enough for twelve men of fair intelligence to reach a unanimous conclusion as trials are conducted; but for twelve ignorant men to do justice is plainly absurd. The fact is recognized among laymen, but lawyers are satisfied and ready to oppose change. The public see the wrong; but while the great majority of thinking people favor a thorough reform, there is in some minds a superstitious fear of attempting anything radical so long as eminent judges or lawyers stand aloof or shake their heads as if it were a sacrilege to uproot those hoary legal abuses and stupidities inherited from the feudal ages. Though bad enough, some of them argue that "we might get something worse," and one journalist goes so far as to claim that we should be satisfied with the legal status because courts of law are better, with all their imperfections, than to settle disputes by arms, as was the course under tribal and barbaric rule!

But besides reforming the jury system by broadening the field of selection and by accepting in many cases a verdict of two thirds or three fourths, it may be reformed also as to certain cases by dispensing with it entirely, at least in its present form. Why not have trained men for jurors as well as for judges? Why is it supposed that twelve men drawn at random, ignorant of law, and unused to weighing evidence, will reach a just decision better than one, three, or five men educated to and experienced in such work? If some sort of training and adaptation are necessary in most other pursuits, why are they not in the difficult work of dispensing justice? In certain cases

the decision might very properly be left to the judge, who, if he chooses now, can, to a certain extent, control the jury. But—on account probably of the jealousy of lawyers—the tendency in recent years has been for the court to express no opinion, but to "instruct" the jury in a way to throw them still more on their own resources by pointing out that, *if* they think so-and-so, then their verdict must be so-and-thus; while if they think the evidence warrants a so-and-thus conclusion, then the verdict must be so-and-so! If the court shows a leaning, and charges in accordance, exceptions are taken, and on an appeal a new trial may be granted, usually with an advantage to one side, particularly in criminal cases. Time dims the edge of one witness's memory, while others may die, or run away, or may come into court with revised testimony, and a case very clear if tried early loses much of its clearness and perhaps some of the witnesses five years after date. Lawyers know this, and in desperate cases count always on the gains of delay. It is an outrage on justice which the people privately anathematize. But what can be done against "the majesty of the law" when lawyers wink at and support the rotten system? Even the judges are silent, and when they do speak it is not to denounce the foundation of abuses of the legal profession. In cases where judges hold office for life, one would expect them to be really independent of bar influences, and ready to lead in the great reforms needed. But, having been lawyers before they were judges, it seems too much to expect that they will rise above bar influences, and hence, as we get little aid from them, it will be left for the people themselves to attach as many modern improvements to jurisprudence as mark our advance in other callings.

Many minor abuses can be mentioned which ought to be easily reformed. One very gross one is the forcible detention of innocent witnesses of a crime. A person far from home, and a stranger, can be imprisoned indefinitely to secure the "ends of justice" in case bail can not be given for attendance at the trial. There is no law to take the testimony of such a witness and discharge him, but legal conservatism requires that he shall "confront" the accused in open court. It is right that this should be done when it does not in itself become a punishment of the innocent, but the bearing of a witness in court has no such value as justifies an outrage on his rights. The testimony might be quickly taken *verbatim*, followed by a cross-examination, with notes as to the witness's "bearing," and he then be left to go his way. As to his credibility, that could usually be ascertained at his residence, and his testimony could then be submitted for what it was worth. This would entail little or no hardship on anybody, and generally would promote the ends of justice quite as well as now. Sometimes, as in an instance in New York in 1885, a crime is committed against a respectable woman, and on making complaint against her ravisher she is imprisoned with thieves and prostitutes to insure

her presence at the trial, while the miscreant who assailed her, being widely known among politicians and saloon *habitués*, remains at large on bail! Such proceedings subvert or discourage justice, but a reform involves so much disturbance of conservatism that a quarter of a century may elapse before it is favored by lawyers.

Abuses in the examination of witnesses often crop out, which tend to discourage litigation and interfere with justice. A lawyer with a bad case, but ambitious to maintain or make a reputation, is quite certain to make the cross-examination of witnesses a terror to any person whom browbeating or insults can throw off his balance. Judges might reform this, but, as in most other law proceedings, the attorney is allowed a latitude out of all reason. A favorite way to confuse a witness is to insist on categorical answers to questions ingeniously framed to reflect on his consistency, and, when any attempt is made at explanation or qualification, to suppress it by bullying and threats. Any man of much observation knows that "the truth, the whole truth, and nothing but the truth," can not be always told by answering "yes" or "no," and for this reason witnesses have a moral right to explain or qualify; but the average lawyer has no regard for that, if a qualified answer is likely to injure his case. The truth is often the last thing he wants, and if he can confuse, or worry, or bully the witness so as to throw doubts on his testimony, it harmonizes with *his* ideas of "the ends of justice." The courts are censurable for allowing this abuse, and it is a pity that there is no appellate or impeachment court to take special cognizance of such offenses, and to punish both judge and lawyer when such outrages are consummated. In other cases the character of respectable witnesses is outrageously attacked in summing up, and trifling, youthful, almost forgotten indiscretions magnified out of all proportion to their importance in order to throw discredit on testimony which can not otherwise be assailed.

It need not be said that crime is rarely punished in proportion to its seriousness, nor that this matter is almost invariably governed by the amount of capital controlled by the criminal for defense. And yet the legal profession, which on occasion has so much to say of its services and its high character, never treats this as a reproach. Probably not one lawyer in a thousand thinks it disreputable to defend the most infamous swindler, defaulter, or bank-robber for pay, thus sharing with him in the avails of his robberies. The well-known fact that the late William M. Tweed was a robber on a colossal scale did not deter "eminent counsel" from defending him persistently until, owing to some informality, his release was ordered by the highest State court. Nobody questioned his guilt, but the conditions of the law are such that an error which did not affect the question of guilt at all was enough to set aside years of costly litigation, and to liberate a smooth-mannered villain whose incarceration for the rest of his worthless life

would not have atoned for his demoralizing career.* And still, what lawyer has been moved by such a defeat of justice as to make any attempt to protect the community against a repetition? Why should any court be empowered to turn loose a notorious robber simply because a single step in the proceedings against him was erroneous though not affecting the question of guilt? A departure from strict rules in election matters is not allowed to affect the result, provided the voter's intent is carried out; and most men of sense will say that technical errors at a trial ought not to vitiate the proceedings, provided no injustice is done. But as long as the lawyer thinks his duty is alone to the client who pays him, and nothing to the public, this debasement of honor and judicial functions will go on.

When a criminal has neither money nor political influence, justice is sometimes swift enough. A New York daily some time ago reported that a common thief, who had snatched a scarf-pin worth a dollar, was "railroaded" through court in a few days and sentenced to five years in the penitentiary, while a saloon-keeper went free who "had been arrested eighteen times in two years on charges of beating, assaulting, and robbing women." But the latter, it was expressly stated, had "political influence," and boasted that he had "a pull" on the courts which would always shield him. Perhaps this was exaggerated; but no observant man can doubt that justice must often fail when the bench is occupied by active associates of leading politicians. The method is not openly to defend and set at liberty, but to rail at and stigmatize witnesses as "informers," to discredit their testimony, make postponements, discharge for alleged informalities, or put over the trial from court to court until public interest is lost, and then to permanently "pigeon-hole" the charges or enter a "*nol. pros.*" This is comparatively easy in communities where certain outlawed immoralities are supported by local public sentiment, such as gambling, lotteries, horse-racing, betting on elections, unlicensed liquor-selling, drunkenness, prostitution, prize-fighting, Sabbath desecration, etc. These can not be made legal, because the State is greater than the city, but local sentiment is usually powerful enough to control the courts, and through them to make the laws a nullity. But with a powerful bar bent on the administration of justice, and not conniving at nor leading in opposition to good laws, this could hardly happen. Hence it is not very wide of the mark to say that lawyers as a class do not take a deep interest in abstract justice, or that they are prominent in agitations for moral reforms. Their training and traditions are against it, perhaps because litigation offers its best rewards in communities where morality and justice are not much recognized—at least until vigilance

* When released from the penitentiary, Tweed was held in bail, to the amount of $3,000,000, in pending civil suits, and, unable to furnish this, was committed to Ludlow Street Jail. A few months later he escaped, but, after hiding about a year, was brought back to the jail, and died there in April, 1878.—Editor.

committees and Judge Lynch supplant the regular courts. That is the natural outcome for any locality where the lawyer, and especially the able criminal lawyer, achieves his highest successes. Lynch law dwarfs immensely the lawyer's importance, and while it is a dangerous remedy for legal evils, it is well to remember that it is best avoided by such an administration of the law as not only gives the criminal a fair chance, but in addition protects society.

It may be charged that a general feeling of hostility to criminal lawyers would make it easy for real criminals to involve the innocent in trouble. This is to be considered; but the history of judicial proceedings in recent years rarely shows that persons leading lives of probity, faithful to every duty of the good citizen, are often arraigned at the bar of justice. In general, under a free government, those charged with great crimes are guilty, and their swift conviction and punishment are demanded by every interest of society. In other cases suspicion may be due to bad habits and bad company, and when this class of people are charged with crimes they have themselves mainly to blame. What is wanted is swift punishment for real transgressors, and that our present system of criminal jurisprudence does not bring. The safeguards provided for the innocent are perverted to the use of the guilty by lawyers who foolishly imagine that their own interests will be promoted through the defeat of justice, forgetful that reactions must come when public interests are persistently disregarded.

A reform of great value to the State would be the education and training of judges at public expense, instead of taking them, as now, from among practicing lawyers. We have a National Military Academy and a National Naval School from which to obtain officers for the army and navy, though only at long intervals and in great emergencies is there any serious need of them; but the administration of justice, which is an every-day need, is left pretty much to chance. The lower courts, those presided over by justices of the peace in the rural districts, as well as the lower grade of city courts, are usually held by petty local politicians, without, generally, any pretense to legal knowledge except such as they obtain from certain printed forms prescribed for them, and whenever an important case is tried by them it is of course appealed. It should be said, however, that in spite of many drawbacks, these petty courts—in the country at least—dispose satisfactorily of a great deal of litigation without a tithe of the cost, delay, and parade of the higher courts, which are invariably presided over by lawyers sitting during regular terms, and where justice is balked at nearly every step by the various arts—impossible for a layman to catalogue—so familiar to lawyers, and with which the judges, from their education and long and close association with lawyers, very earnestly sympathize. If the United States, or each State, had a school for the education of judges in which the course of study, in addition to a knowledge of the principles of law, aimed to fit the pupils to admin-

ister justice without much regard to mere technicalities or legal hair-splitting, and which kept in view, first and foremost, that the courts were for the benefit *of the people at large*, and not to furnish a living for lawyers, the gain to justice would be something akin to what modern inventions have given us in contrast with the methods of former generations. From the graduates of these schools our judges should be appointed to serve during good behavior, with promotions regulated according to ability in the discharge of duty, and seniority of service where otherwise there was equality, such considerations to rule as would secure the best service. The details for such a school, and for selections from its alumni, could be readily worked out, but are unnecessary here. The gradations of courts, after the system was once inaugurated, would give the new graduates the necessary experience from the lower courts up, and would bring into the service a class of judges who, owing nothing to the lawyers, would not be influenced by them in any schemes for delaying or defeating justice, or in allowing them enormous fees because great sums were at stake. These judges should take the place of lawyers to a certain extent in examining witnesses, so as to draw out the whole truth and only the truth, instead of only such parts of it as suit the *ex-parte* counselors. As long as the lawyer was an aid to the court he might be tolerated and encouraged, but when he proved an obstruction the mandate of the court should remind him of his true work and keep him in line with it. Such a system would greatly discourage the unscrupulous and "bumptious" lawyer, of course, because it would dwarf his importance; but if justice can be so administered as to do without him, and to turn his talents into more useful channels—for instance, the mechanic arts, agriculture, auctioneering, mining, cattle-driving, etc.—who will complain? Every new invention cripples or overturns some vested interest to promote something better; and if, after centuries of long-suffering and forbearance, the grip of the lawyer class can be shaken off and justice administered with speed, regularity, and exactness, and at a great reduction in cost, it would be a consummation worth other centuries of effort, and be the best token of an advancing civilization.

Another much-needed reform is to sweep away the useless verbiage that now so greatly encumbers law papers and makes them legal terrors. The reader will best appreciate this suggestion by trying to "digest" the clause of a warranty deed following the names of the parties, and which assumes to state the purpose of the document, thus:

"**Witnesseth**, That the said party of the first part, for and in consideration of the sum of —— dollars, lawful money of the United States of America, to us in hand well and truly paid by the said party of the second part, at or before the ensealing and delivery of these presents, the receipt of which is hereby acknowledged, and the said party therewith fully satisfied, contented, and paid, have given, granted, bargained,

sold, aliened, released, enfeoffed, conveyed, and confirmed, and by these presents does give, grant, bargain, sell, alien, release, enfeoff, convey, and confirm to the said party of the second part and his heirs and assigns forever: all that certain tract or parcel of land and premises hereinafter particularly described, situate, lying, and being in the township of Snipe, county of Woodcock, and State of Huckleberries, bounded and described as follows, to wit." Here the legal description is inserted with comparative simplicity. One would think when that was ended it would complete the transaction, so that "the party of the first part" could sign the deed, take his money, and go home; but not yet, as two hundred and thirty-two words are then used to say that the purchaser is not only to own the land, but everything on it; that it is for his heirs as well as for himself, "forever"; that the land is unencumbered by debts, and the title "as good as wheat." Then comes the warranty clause already mentioned, containing one hundred and sixty-two words full of sound if not of sense; then the signature of the seller and of his wife, if there be a wife; then the seals, another relic of feudal ages; then the signature of the witnesses, and then a formal acknowledgment before some official whose one pleasurable duty is to exact a fee. The seller is then let off; but the buyer, if he desires his deed secure against thieves, fire, or a second deed of later date, must have all the beautiful rubbish in it recorded by a salaried official deputed for that work, who charges another fee, and keeps the copy in a fireproof building at the cost of the county.

Now, in place of this ingenious and ridiculous piece of legal circumlocution, let us see if something could not be devised which would express the same ideas, and hold all the parties to the contract—something like this:

This deed, made this —— day of ——, in the year A. D. 1887, witnesseth: That I have this day sold to John Smith, of etc., for one thousand dollars, the following described piece of land, with everything on it known as real estate, situated in the town of ——, county of ——, and State of ——, bounded as follows: (Description here inserted.)

And I hereby warrant the purchaser, John Smith, that I am the lawful and only owner of the said land; and also that there are no claims to encumber it; and that his title hereby becomes indisputable.

JOHN DOE.

When two men make a verbal contract involving a horse-trade before reliable witnesses, the courts hold them to it without a scrap of written agreement. When one man gives his note for value received to another, he is held to this agreement if a clear intent is indicated, no matter if the note is bunglingly expressed and half the words misspelled. A man who can not write his own name can still convey away his real estate by affixing "his mark" to his name after some-

body else writes it; and a verbal promise, indicated by a nod before some authorized magistrate or clergyman, binds two persons of opposite sexes to each other in marriage for life. All the vast interests of the kingdom of Great Britain are regulated and controlled by an imaginary "constitution"—one never written or printed, but which seems, Topsy-like, to have "growed" out of customs adapted to the hour, and which come to the present generation as traditions, and which are accepted and interpreted by the British courts with as much reverence as though everything had been written out, sanctioned by the people, and filed, as with us. Even British "common law" is nothing more than ancient customs accepted as laws, and interpreted as such with as much care and exactness as though they were statute laws sanctioned by Parliament. All this shows that the mass of verbiage in legal documents has no basis of necessity for its existence when courts administer justice according to certain general principles, and that the excuse for its retention has some other purpose than justice between buyer and seller.

A large part of our litigation is due to laws which embody contradictory or unconstitutional provisions, or are so vaguely expressed that judicial decisions are necessary to their interpretation. In this, too, the "fine work" of the able lawyer is apparent. The inexperienced or non-observing citizen would suppose that a Legislature of lawyers would enact statutes about which there could be no ambiguity and no conflict with higher laws. The lawyer is not slow to express apprehension about the fitness of plain citizens to enact laws, and of the necessity for a legal supervision of embryo statutes, in order that they shall not shock conservatism nor create disorder in the body politic. To every Legislature he goes in force, generally making a majority, and sometimes a two-third majority, carried there in triumph by those brilliant qualities which distinguish his profession, popularly known as "cheek," in addition to wire-pulling and that trinity of political virtues aptly described by a Pennsylvania politician as "addition, division, and silence." In the Legislature his work may be described as that which first and foremost guards on all occasions the interests of "number one." When a proposed law is crude, ill-digested, or of doubtful constitutionality, it never alarms him, because it is such that need interpretation by the courts. Then, again, his constituency may require his support of certain measures which he privately abhors, and to kill or cripple such measures with crude, incongruous, or unconstitutional amendments is usually regarded by him as statesmanship of a high order. A body of men chosen without solicitation of their own, and because of intelligence and high moral character, would scorn such work, but the lawyer regards them generally as "cranks" or "impracticables." A good legislator must be something of a plodder, ready to do a great deal of inconspicuous work. He must watch legislation very closely, particularly the work done in committees, and

in each Committee of the Whole. He must see that the various bills are in the public interest—not in the interest of cliques; that they are in harmony with the Constitution; and also that the various sections of each bill are in harmony with each other. This is a sort of drudgery which the new country member, chosen because of conspicuous personal worth, accepts as part of his duty, but which the "smart" lawyer shuns, because *his* mission at the capital is above that of being a "legislative drudge." The time for him to study legal phraseology and the adaptation of laws to their purpose is when he is paid for it. As to legislation in behalf of morals, he has generally no faith in it, his idea being that morals should take care of themselves, or be left to preachers and Sunday-schools.

Public sentiment is ripe for leadership in this reform, and it will come sooner or later, whether lawyers acquiesce or not. Honorable lawyers ought to see that their interests center in the conservation only of what is useful, and not in ignoring or defying public impatience until it finds vent in revolutionary measures. The principle of *the greatest good to the greatest number* is what needs recognition—not protection to a remnant of the feudal ages.

HYPNOTISM IN DISEASE AND CRIME.*

By A. BINET AND C. FÉRÉ.

WHAT we have said of hypnotism, and particularly of suggestion, may lead the reader to understand the virtue of medicine for the imagination, of which the importance has already been intimated by earlier writers. Deslon asked why, if medicine for the imagination was the most effective, it should not be employed.

We must be permitted to dwell for a moment on this medicine for the imagination, which is entitled to the name of suggestive therapeutics. The process is as follows: Influenced by a persistent idea, suggested by external circumstances, a paralysis is developed. The physician makes use of his authority to suggest the idea of an inevitable, incontestable cure, and the paralysis is cured accordingly. This cure, as well as the development of functional disturbance, was directly effected by an idea. An idea may, therefore, be, according to circumstances, a pathogenic and a therapeutic agent. This notion is not new, but, since it was misinterpreted, it has remained unfruitful.

The most important of the organic disturbances produced by an idea is an experiment on vesication, performed by Focachon, a chemist at Charmes. He applied some postage-stamps to the left shoulder of

* Abridged from "Animal Magnetism," by Alfred Binet and Charles Féré. "International Scientific Series," vol. lix. D. Appleton & Co., 1888.

a hypnotized subject, keeping them in their place with some strips of diachylon and a compress; at the same time he suggested to the subject that he had applied a blister. The subject was watched, and when twenty hours had elapsed the dressing, which had remained untouched, was removed. The epidermis to which it had been applied was thickened and dead and of a yellowish-white color, and this region of the skin was puffy and surrounded by an intensely red zone.

It was in 1869 that Russell Reynolds first noted the existence of motor and sensory disturbances, developed under the influence of an idea. The motor disturbance sometimes consists in spasms, in ataxic or incoördinated movements, and more frequently in paralysis which affects the upper limbs. Erb gives to these symptoms the name of imaginative paraplegia.

The type of this paraplegia is afforded by Reynolds's first observation, which concerned a young woman who was affected by paraplegia under the following circumstances: She lived alone with her father, who had undergone a reverse of fortune, and who became paralytic in consequence of protracted anxiety. She supported the household by giving lessons, which involved long walks about the town. Influenced by the fatigue caused by so much walking, it occurred to her that she might herself become paralyzed, and that their situation would then be terrible. Haunted by this idea, she felt a growing weakness in her limbs, and after a while was quite unable to walk. The pathology of the affection was understood by Reynolds, who prescribed a purely moral treatment. He finally convinced his patient that she was able to walk, and in fact she resumed the practice.

Diseases have been termed imaginary, or diseases caused by the imagination, and this confusion of terms has confirmed the confusion of ideas. We have, however, just shown, especially by means of the facts which relate to paralysis by suggestion, that diseases caused by the imagination—that is, produced by a fixed idea—are real diseases, and, at any rate in some cases, display undisputed objective symptoms.

Since the existence of real diseases, produced by means of the imagination, is proved, it is thereby proved that imaginary diseases do not and can not exist; by this we mean purely fictitious diseases, since as soon as the subject has accepted the fixed idea that he is affected by any functional disturbance, such a disturbance is in some degree developed. It should be added that these diseases, produced by means of the imagination, are not merely influenced by a local disturbance; the subject who allows himself to be dominated by this idea of disease must be peculiarly excitable and open to suggestion; he must be endowed with a condition of congenital psychical weakness which is frequently found in conjunction with more or less strongly marked neuropathic manifestations, or with physical malformations. As Lasègue observed, not every one who pleases can be hypochondriac.

This distinction throws light on the therapeutics of diseases produced by means of the imagination, or suggested diseases.

When one of these victims to hypochondria, anæmic and emaciated, who are usually called *malades imaginaires*, has recourse to medicine, on the plea of suffering pain or some other subjective disturbance, he is usually told that it is of no importance, that he is rather fanciful and should think less about his health, and some anodyne is carelessly prescribed. The patient, who is really suffering from the pain he has suggested to himself, feels convinced that his malady is not known, and that nothing can be done for him. The idea that his complaint is incurable becomes intense in proportion to his high opinion of his physician's skill, and thus the patient, who was suffering from the chronic affection suggested by his imagination, often goes away incurable.

Those who undertake miraculous cures act very differently. They do not deny the existence of the disease, but they assert that it may be cured by supernatural power. They act by means of suggestion, and by gradually inculcating the idea that the disease is curable, until the subject accepts it. The cure is sometimes effected by the suggestion, and when it is said to be by saving faith, the expression used is rigorously scientific. These miracles should no longer be denied, but we should understand their genesis and learn to imitate them.

When a believer associates the Deity with his idea of cure, he is accustomed to expect it to be sudden and complete, as the result of a definite religious manifestation; and this, in fact, often occurs. We had a well-known instance at the Salpêtrière, when a woman of the name of Etcheverry was, after her devotions in the month of May, suddenly cured of a hemiplegia and contracture, by which she had been affected for seven years. Only a slight weakness of the side remained, which disappeared in a few days, and which could be explained by the prolonged inaction of the muscles. This may be termed an experimental miracle, since the physicians had prepared for it beforehand, having for a long time previously suggested to the subject that she would be cured when a certain religious ceremony took place, and it is a miracle which explains the numerous cures by the laying-on of hands which are recorded in the Bible. If we do not go further back than the last century, suggestion explains the cures by Greatrakes, the exorcisms by Gassner, Mesmer's successes, and the miracles performed at the tomb of the deacon Paris in the cemetery of Saint Médard; and in our day, in the famous caves on the slopes of the Pyrenees.

The resources of the physician, who does not profess to be a thaumaturgist, are more scanty. When he is consulted by a patient whose disease has a psychical origin, he is unable, unless in some exceptional circumstances, to inspire confidence in remedies which are not more or less gradual, but, whatever they are, he must prescribe with firmness and authority. It is a well-known fact that the hydropathic treatment of some forms of hysteria has afforded more speedy results than other

modes of treatment, merely from the fact that suggestion has been employed at the same time. This remark also applies to massage, etc., under analogous circumstances.

We are particularly anxious to call attention to the effect of moral treatment, and to the part taken in it by suggestion. This is no new thing; when the so-called fulminating pills are administered, suggestion is employed in the pilular form, and when pure water is injected under the skin, suggestion takes a hypodermic form. This medicine for the imagination is particularly to be recommended in that category of diseases which are of definite psychical origin.

This is not the place for insisting on the special indications of suggestion in therapeutics. The study just made is enough to show to what extent it may act on motor, sensory, or psychical phenomena, and consequently how it may be usefully employed in the treatment of the dynamic disturbances which are due to the influence of a psychical action, of a moral shock, or even of a peripheral excitement. Its effect can not any longer be disputed. It is, however, still difficult to give a rigorously scientific account of the results obtained, since few observations have as yet been published, and in some of these it is impossible to find an objective characteristic of hypnosis. Others, again, are incomplete, or published by incompetent persons, whose descriptions do not carry with them a conviction of the reality of the morbid state in question. Finally, precisely on account of the nature of its action, which is exclusively exerted on diseases in which there is no definite material lesion, and which are, therefore, purely dynamic, suggestion only cures affections which are capable of spontaneous modification, or which are influenced by various external agents. At present, therefore, it is difficult to establish the real value of this mode of treatment, although less difficult than in the case of many remedies in general use. It can only be said that it is founded on accurate notions of mental physiology, and consequently on a rational basis.

Since the possibility of curing a certain number of nervous diseases by means of hypnotism is established, it can not be disputed that physicians are justified in making use of it, under the same reservation as any other methods of therapeutics. The physician's responsibility is diminished if he has to treat an affection which would not yield to other measures; if he has obtained the consent of his patient and the concurrence of the patient's friends; and, finally, if he can show that he has acted prudently, with due consideration of the danger incurred by the patient, and with proper precautions against these risks.

Since the past history of hypnotism verged upon the marvelous, it had the privilege of exciting the curiosity, not only of learned men but of people in general. Exhibitions with which science had nothing to do made the public acquainted with a certain number of phenomena of which a criminal use might be made, and hypnotic sleep and suggestion have played a part in several judicial dramas. We think it

may be profitable to consider this subject, which is indeed entitled to further development.

Somnambulist subjects often display a kind of attraction for the experimenter who has hypnotized them by touching the scalp. As soon as the experimenter has pressed upon the scalp with his hand, or has breathed upon the subject with his mouth, the latter is attracted toward the experimenter; if the experimenter withdraws to a distance, the subject displays uneasiness and discomfort; he sometimes follows the experimenter with a sigh, and can only rest beside him. It is probable that the phenomena of electivity have their origin in the experimenter's contact with his subject. Bain, in his work on the emotions, remarks that animal contact and the pleasure of an embrace are the beginning and end of all the tender emotions.

The dangers of this attraction with respect to morality were pointed out in the secret report presented to the King of France in 1784, by a commission which had been appointed to investigate the practice of magnetism by Deslon, Mesmer's chief pupil. The following is extracted from this report:

Women are always magnetized by men; the established relations are doubtless those of a patient to the physician, but this physician is a man, and whatever the illness may be, it does not deprive us of our sex, it does not entirely withdraw us from the power of the other sex; illness may weaken impressions without destroying them. Moreover, most of the women who present themselves to be magnetized are not really ill; many come out of idleness, or for amusement; others, if not perfectly well, retain their freshness and their force, their senses are unimpaired, and they have all the sensitiveness of youth; their charms are such as to affect the physician, and their health is such as to make them liable to be affected by him, so that the danger is reciprocal. The long-continued proximity, the necessary contact, the communication of individual heat, the interchange of looks, are ways and means by which it is well known that nature ever effects the communication of the sensations and the affections.

The magnetic treatment must necessarily be dangerous to morality. While proposing to cure diseases which require prolonged treatment, pleasing and precious emotions are excited—emotions to which we look back with regret and seek to revive, since they possess a natural charm for us, and contribute to our physical happiness. But morally they must be condemned, and they are the more dangerous as it becomes more easy for them to become habitual. A condition into which a woman enters in public, amid other women who apparently have the same experience, does not seem to offer any danger; she continues in it, she returns to it, and discovers her peril when it is too late. Strong women flee from this danger when they find themselves exposed to it; the morals and health of the weak may be impaired.

It is possible to suggest to a subject in a state of somnambulism fixed ideas, irresistible impulses, which he will obey on awaking with mathematical precision. The subject may be induced to write down promises, recognitions of debt, admissions and confessions, by which he may be grievously wronged. If arms are given to him, he may also be induced to commit any crime which is prompted by the experi-

menter. We could cite several acts, to say the least unseemly, committed by hysterical patients, which were crimes in miniature, performed by an unconscious subject, and instigated by one who was really guilty, and who remained unknown. At the Salpêtrière a paper-knife has often been placed in the hands of an hypnotic subject, who is told that it is a dagger, with which she is ordered to murder one of the persons present. On awaking, the patient hovers round her victim, and suddenly strikes him with such violence that I think it well to refrain from such experiments. It has also been suggested to the subject to steal various objects, such as photographs, etc.

To give an idea of the mathematical precision with which the suggested act is executed on awaking, one of the present writers performed the following experiment: We showed to the somnambulist an imaginary spot on a smooth surface, which we could only afterward ascertain by means of careful measurement, and we ordered her to stick a penknife into this spot when she awoke. She executed the order without hesitation and with absolute correctness: a criminal act would have been as punctually executed.

It is interesting to ascertain whether the subject who is actuated by an irresistible impulse behaves like an automaton subsisting on a basis of the past, on his memory and habits, or if, on the contrary, the subject is capable of reflection and of reasoning like a normal individual. This latter is more frequently the case. When care is taken to suggest a somewhat complex act, for the performance of which some combination is necessary, we may observe that the subject invents such combined expedients although they had not been suggested to him, and this inventive process shows that everything is not explained by comparing him to an automaton. For instance, it was suggested to a subject that she should poison X—— with a glass of pure water which was said to contain poison. The suggestion did not indicate in what way the crime was to be committed. The subject offered the glass to X——, and invited him to drink by saying, "Is it not a hot day?" (It was in summer.) We ordered another subject to steal a pocket-handkerchief from one of the persons present. The subject was hardly awake when she feigned dizziness, and staggering toward X——, she fell against him and hastily snatched his handkerchief. When a similar theft was suggested to a third subject, she approached X——, and abruptly asked him what he had on his hand. While X——, somewhat startled, looked at his hand, his handkerchief disappeared.

These facts show that the hypnotic subject may become the instrument of a terrible crime, the more terrible since, immediately after the act is accomplished, all may be forgotten—the crime, the impulse, and its instigator.

Some of the more dangerous characteristics of these suggested acts should be noted. These impulses may give rise to crimes or offenses of which the nature is infinitely varied, but which retain the almost

constant character of a conscious, irresistible impulse; that is, although the subject is quite himself, and conscious of his identity, he can not resist the force which impels him to perform an act which he would under other circumstances condemn. Hurried on by this irresistible force, the subject feels none of the doubts and hesitations of a criminal who acts spontaneously; he behaves with a tranquillity and security which would in such a case insure the success of his crime. Some of our subjects are aware of the power of suggestion, and, when absolutely resolved to commit an act for which they fear that their courage or audacity may fail when the moment arrives, they take the precaution of receiving the suggestion from their companions.

The danger of these criminal suggestions is increased by the fact that, at the will of the experimenter, the act may be accomplished several hours, and even several days, after the date of suggestion. Facts of this kind, which were first reported by Richet, are not exceptional, and have been repeatedly observed by us.

The reality of this class of facts can not now be disputed, but the difficulty of proof in any given case is considerable. We have not, in the case of impulsive acts, the same objective criterion as we have in hallucinations and in the paralysis of movements and of sensation. It is, therefore, necessary for the expert to be cautious in his judgment.

Loss of memory is one chief characteristic of the facts of suggestion. The hypnotic subject does not know from whom, when, and how the suggestion was received. This amnesia may be either spontaneous or suggested, and it is a phenomenon of the waking state, which disappears when the subject is hypnotized anew. The recollection of all which occurred during hypnosis is then revived, and the subject is able to indicate, often with remarkable precision, the author of the suggestion, the place, day, and hour when it was made to him, always supposing that he has received no special suggestion of complete oblivion. Hence the question occurs whether an accused person who appeals to an hypnotic suggestion for his defense, and who submits to experiment, can be profitably examined at a time when he displays all the physical characteristics peculiar to the somnambulist state, so that there is no danger of imposture. We have had occasion to show that some subjects are in this state capable of suppressing the truth, and Pitres has shown that deceit was not impossible. An hypnotic subject may at the same time be criminal, and suggestion must be accepted only so far as it admits of material proof, or at any rate as far as it can be necessarily deduced from the facts of the case.

DR. SCHUNK, in the British Association, prognosticating the future of chemistry, thought that pure or systematic chemistry becoming practically exhausted in the course of time from the want of new compounds to prepare, the future fields of the science would lie in such lines as the growth-processes of plant-substances and of those agents to which decomposition and decay are due.

CALIFORNIAN DRY-WINTER FLOWERS.

By Professor BYRON D. HALSTED.

THE writer spent three months of the winter of 1886–'87 in and around the cities of Los Angeles and Santa Barbara in Southern California. The previous summer had been no exception to the rule, and the whole country received no rain from the last of April until the close of the year. In fact, the long-expected rains did not come until the middle of February, and we left in the midst of the raging floods. The wild plants, therefore, which were in bloom from December until February, had not felt the invigorating influences of water from the clouds for nearly ten months.

It is the purpose of this paper to call attention to the winter-blooming plants found upon the highlands, or at least not growing along the streams or within easy reach of water coming from any natural springs or other perennial sources of moisture. The roadways, for example, during the winter, were deep with dust, and every passing breeze carried the impalpable powder in a fine cloud over all surrounding objects.

The first plant bearing blossoms that attracted our attention was the western bindweed (*Convolvulus occidentalis*, Gray). This perennial, twining herb seemed to flourish in the driest earth, and hung out its white or purplish flowers to catch the dust as well as the winter sunshine. Unlike its first cousin, the common morning-glory, as we see it in the East, this wild convolvulus keeps its flowers open the whole day through, and, for aught we know, for several days in succession. This would only be in keeping with other living things in that quiet, lazy climate, where there is no real winter, or the activity exhibited among plants in localities where they must prepare for impending frosts. A very common species in flower was *Galium angustifolium*, Nutt. This is one of the larger "bed-straws," and may be found in almost any thicket climbing to the height of three or more feet over the dusty and leafless branches of the surrounding shrubbery. The flowers are very small and inconspicuous, but are present in large numbers. The fact that this is one of the polygamo-diœcious species adds interest to it. Botanists have puzzled over it to some extent on account of there being male and female plants, which differ somewhat in general appearance. Upon this species it was interesting to observe the long, slender, and apparently lifeless stems from which sprang at frequent intervals the green, leaf-bearing branches with their large clusters of small flowers. There was an adaptation to circumstances, and young shoots were developed where they would do the most good. One species of the "painted cup" (*Castilleia parviflora*, Bon.) was occasionally met with in the open grounds, but it looked the worse for

its winter's wear. This species is covered with a villous pubescence, and this with the accumulation of dust rendered the inflorescence far from a brightly "painted cup." The flowers are, however, not small, as the specific term would suggest. They are well-nigh as large as those of *C. coccinia*, Spr., of the Middle States. Another member of the same family is the *Scrophularia Californica*, Cham., or California figwort. This was not abundant, and might be easily mistaken for the Linnæan species *S. nodosa*, L., of Europe and the Atlantic States. The western species may, however, be distinguished by the coarsely, doubly incised, or sometimes laciniated leaves, and by the sterile stamens being spatulate or pointed near the apex. Like the eastern species, this is a fine illustration of proterogyny in flowers fertilized by means of insects. The pistil first appears upon the lower lip of the flower. After the style has become flabby and reclined upon the corolla, the four stamens take its former place and shed their pollen upon the bodies of nectar-seeking insects.

A "four-o'clock," one of the three species within the Golden State, namely, *Mirabilis Californica*, Gray, was found, with its viscid pubescent, thickish, almost sessile leaves coated with dust, while the small rose-purple flowers were in striking contrast with their surroundings. We found this one of the most difficult of all species to prepare for the herbarium. After weeks of drying, the viscid covering would still remain. At least two species of nettles were found in bloom, but as far as showiness goes they might as well have been in fruit! Around Los Angeles there is a very coarse, tall species (*Urtica Breweri*, Wat.), which reaches above a person's head, and is loaded with the green panicles of flowers. The leaves are frequently six inches long and finely pubescent. The stems are hispid, and the stinging hairs produce a burning sensation upon the flesh that is akin to numbness, which lasts for several days. One of the ancient natives, observing the writer among these much-dreaded plants, volunteered the information that they were worthless and much to be avoided. He could see no reason why any one would deliberately handle such vile things. The small, slender, stinging nettle of Europe (*Urtica urens* L.) was also in bloom.

Among the *Compositæ* we note *Centaurea militensis*, L., or star-thistle, with its heads armed with a spinose involucre, which includes the pink flowers. This is one of the miserable weeds of waste places that has effected an entrance from the Old World. The *Gnaphalium margaritaceum* of Linnæus, now placed in the genus *Anaphalis*, D. C., with its white, woolly, leafy stems, and pearly, scaly involucres, was frequently met with, and sustained its old-time reputation for being one of the beautiful "everlastings." The most showy of all the herbaceous composites was the *Solidago Californica*, Nutt., which is a strict-stemmed plant, about three feet high, with lanceolate entire leaves, and a pyramidal panicle of racemose heads of yellow flowers. This is the Californian representative of *S. nemoralis*, Ait. The

golden-rods on the Pacific coast are few in number, less than one tenth of the United States species being represented in California. The most striking composite is the *Senecio scandens*, L., or German ivy, which in many places has escaped from cultivation and grows rampant in the low grounds, where it climbs to the tops of medium-sized trees, and embowers them in a perfect profusion of bright-yellow blossoms. A few specimens of a helianthus, probably *H. Californicus*, D. C., were found, but a dry winter is not favorable for the sunflowers, especially the annual sorts.

Only one species of the *Cucurbitaceæ* was in bloom—namely, *Megarrhiza Californica*, Torr. This was running over the dry soil like an aristocratic cucumber-vine, with its white male flowers in slender racemes, while here and there a forming fruit exhibited its green covering of sharp, stout spines. We were anxious to secure some of the large seeds to illustrate the remarkable manner in which the cotyledons find their way to the surface of the soil in germination, but were unsuccessful. This "big root," as its generic term indicates, is probably able to obtain more moisture than most other plants growing in similar situations, and which do not strike their roots so deeply into the soil or utilize them as storehouses for accumulated nourishment. This megarrhiza is exceedingly provident, and is, therefore, able to grow where shallow plants succumb to the drought. In the same soil flourished the *Lupinus rivularis*, Doug., and the Californian peony (*Pæonia Breweri*, Doug.). The lupine is a short-stemmed plant, bearing large, palmately compound leaves of seven to ten leaflets, and terminating in a raceme often two feet long, bearing a large number of beautiful purple flowers. The peony is a ternately compound-leaved perennial, with but a few large blossoms, which assert at sight the close alliance of this species with the peonies of the garden. These last three species were objects of rejoicing as the eye wandered over the otherwise almost flowerless tracts in the broad, bowlder-scattered cañon. Not far from the above locality it was a surprise to run upon *Nicotiana tabacum*, L., our common tobacco, growing wild and in full bloom. These plants had escaped from some Mexican garden, or perhaps the old garden had escaped from the slack and profitless culture of the Mexican.

The species that seemed the most at home of all the dust-bloomers was the old vervain (*Verbena officinalis*, L.) of Europe. This species grows in nearly all parts of the globe, and is very likely naturalized in many countries, including California. From out of the heavy covering of dust which is held by the minute pubescence, the purple corollas are spread along the lengthy spikes. Nearly all of the specimens have the older spikes much swollen and otherwise distorted by infesting insects.

Phacelia is a large genus in California, numbering thirty-five species. A few of these members of the order *Hydrophyllaceæ* were in bloom, among which the *P. ramosissima*, Doug., was the most common. It would seem as if earth could not get too dry for this

straggling, hispid, or glandular-viscid plant to thrive. The variety *hispida*, Gray, was the most common form at Santa Barbara, and is a very unpleasant thing to handle. A large quantity of the pinnately divided leaves and prickly stems was gathered, as they were much infested by a cluster-cup (*Æcidium*) fungus. At least one species of *Cuscuta* was collected, viz., *C. Californica*, Choisy; but, as all the dodders are parasitic, it is not strange to find them flourishing even while their hosts were leafless and being robbed, so to speak, in their sleep. The species is quite variable, and the extreme forms have been defined under var. *breviflora* and var. *longiloba;* both by Dr. Engelmann, the great and almost life-long student of these sickly parasites.

The dry earth in old stubble-ground was in some places found entirely covered with a carpet of *Calendrinia Menziesii*, Hook., a fleshy-leaved acaulescent plant of the purslane family, and in habit not unlike its cousin, the obese purslane (*Portulaca oleracea*, L.), so frequently spreading over eastern fields and gardens with its low, fleshy stems and leaves. Both seem equally well adapted for thriving in hot and dry places. A downy mildew (*Peronospora*) was, however, making inroads upon this calendrinia, although not, perhaps, as fatal in its work as to *Claytonia perfoliata*, Down. These two hosts are in adjoining genera, and the peronospora seems to be the same in both cases. The claytonia was in flower, but as this "spring beauty" only thrives in moist places, it does not come within the province of this paper. Occasionally a flower of the popular forage plant of the foot-hills, the alfileria, or "pin-grass," was seen, but only when there was some chance for moisture. This low, leafy crane's-bill (*Erodium cicutarium*, L., Her.) grows rapidly when the rains come and clothes the pastures and foot-hills with a rich carpet of green, followed by a profusion of flowers, unless the cattle and sheep keep it closely cropped.

As a transition to the woody plants, mention may be made of a variety of black nightshade (*Solanum nigrum*, var. *Douglasii*, Gray) which grows abundantly in all parts of the country. It is, perhaps, most at home along the streams or upon the lower areas, but it may be seen almost everywhere, forming clumps six feet high, and shrubby at the base. It can usually be found bearing blossoms and fruit in all stages of development, and is one of the coarser weeds that is quite sure to find its way into cultivated ground and become thoroughly established if sufficient time is given it. Much more attractive than the above is *Solanum umbelliferum*, Esch., which forms long, straggling, tomentose stems, that climb over surrounding shrubbery and peep out here and there with small clusters of large, yellow-throated, blue flowers. This forms one of the cheerful surprises as a person pushes his way through the dust-laden underbrush. In the same localities the flower-hunter will encounter tangling masses of a poison-ivy (*Rhus diversiloba*, T. and G.), called by the natives "yeara" or "poison-oak." The vines grow rapidly, and the shining, newly-devel-

oped leaves are in striking contrast with the dust-begrimed stems and foliage over which the treacherous and baneful vines climb. The "poison-oak" differs from the poison-sumac of the East (*Rhus toxicodendron*, L.), in having sharply-toothed leaflets, nearly sessile panicles, and close clusters of fruit. The writer has been poisoned by both species, and can testify that the sensations of burning and itching of skin of face and fingers are practically the same for both kinds. The leaves of a common composite called "gum-plant" (*Grindelia*) are bruised and rubbed over any exposed part of the skin as a preventive.

The most attractive flowers, both as to appearance and fragrance, were those of the phlox-like *Gilia Californica*, Benth. This shrub is two or three feet high, and grows upon the dry hill-sides. The leaves are thickly set and villous, while the stems are terminated by clusters of rose- or lilac-colored flowers an inch or more across the limb. The fragrance is indescribably rich, when not too profuse. The peculiar foliage and the extreme delicacy of tint and fragrance of the flowers place this "mountain pink" at the head of the list of flowering plants during a winter drought. Not far below the Gilia in attractiveness is a member of the large genus *Hosackia* (*H. glabra*, Torr.), of the order *Leguminosæ*. This species has slender, woody stems several feet in length, which bend and become decumbent or rest upon surrounding shrubs. In color the flowers are a mixture of yellow and brown, closely set upon the curved, drooping stems, and are not obscured by the small leaves. The sprays might well serve for making delicate wreaths. This is one of the most common winter-bloomers of the pea family. In the same localities the large vetch *Lathyrus vestitus*, Nutt., with its rose or violet flowers, was frequently found making an entangled mass of wiry stems several feet in length. It seemed most at home along the rocky sides of cañons, where it could climb to its heart's content.

The wild blackberry (*Rubus ursinus*, C. and S.) was abundantly in bloom from the lateral branches upon the long canes. There is an absence of any compactness of growth; the main stems trail along for twenty feet, perhaps. The almost impenetrable entanglement made by such a growth, when climbing over and among shrubs, may be more easily experienced than imagined. Two of the shrubby composites were found in bloom—namely, *Baccharis pilularis*, D. C., and *B. viminea*, D. C. Both species grow much higher than a man's head, and sometimes the stems attain two or three inches in diameter. Both are badly infested with *Coleosporium baccharidis*, C. and H.—a rust which attacks all parts of the plant and causes large swellings in the older stems. This is one of the best illustrations of the perennial nature of some of the parasitic fungi when the host is under favorable conditions for indefinite continuous growth.

The *Ribes speciosum*, Pursh., is an attractive, fuchsia-like goose-

berry, and quite distinct from all other *Ribes*. As the branches hang loaded with the clusters of drooping flowers, like beautiful ear-pendants of rich hues, this is one of the most striking sights among the dust-laden vegetation. No one is, however, much inclined to gather quantities of the canes for home decoration, because they are generously provided with prickles, which stand guard upon all sides, and effectively keep away whatever would bring harm. *Sambucus glauca*, Nutt., is the elderberry of California. It grows less like a shrub and more like a tree than our old *S. Canadensis*, L., and the leaves are of a firmer texture. The greenish-white flowers are in large, flat-topped cymes.

The California lilac (*Ceanothus thyrsiflora*, Esch.) is a showy winter-bloomer, and well merits the attention it receives as an ornamental shrub. The plant attains a height of ten to fifteen feet, and the large lead- or lilac-colored flower-clusters appear before the leaves. These are frequently gathered in abundance by tourists for showy bouquets. *Rhamnus Californica*, Esch., of the same order, was loaded with its inconspicuous flowers. A wild prunus was in full bloom, and reminded the writer of spring days in the Atlantic States. The leaves and fruit were not at hand, and the species was not therefore determinable. The mountain-laurel, or "spice-tree" (*Umbellularia Californica*, Nutt.), is the only representative of the olive family in the section visited. This is symmetrical in form, with thick, shining leaves. The flowers are borne in clusters, apparently at the ends of the straight branches. All parts of the tree are pervaded with a disagreeable odor, which becomes quite intense when the fresh foliage is broken, and it may excite sneezing in extreme cases.

Among forest trees, we saw the young bolls hanging from the recently clothed branches of the *Platanus racemosa*, Nutt., or sycamore. This tree, along with the live-oak (*Quercus agrifolia*, Nees), is common in the cañons, reaches a large size, and assumes picturesque forms and positions. The small male catkins were hanging from the short ultimate branches of the live-oak. *Alnus rhombifolia*, Nutt., was opening its gummy inflorescence, while the willows were arrayed in their delicate "pussies."

When we come to the introduced ligneous plants of the city roadside or plaza, where no water is supplied by irrigation, we find the blue gum (*Eucalyptus globulus*), from Australia, the most showy of the trees. These began to flower in Los Angeles by the 20th of January, and a month later those in Santa Barbara were so loaded with the large, top-shaped disks and their whorls of long, white, feathery stamens as to change the somber complexion of the tall, sparsely branched trees. The bees were sometimes so numerous in these trees as to remind one of an eastern basswood during honey-harvest. The pepper-tree, with its drooping, graceful, fern-like tops, seems to be always in flower. On the same plant may be seen all stages, from the

small flower-buds to the ripe, rose-colored berries. This very popular shade-tree belongs with the sumacs and poison-ivy, and is pervaded with a bitter, milky juice. Various species of acacias were in bloom. Good specimens of phyllodia were obtained from these trees, loaded with their small spheres of fine flowers.

The orange, lemon, and lime, in the genus *Citrus*, are all examples of plants that may have flowers and ripe fruit at the same time. This is most frequently true of the lime, next of the lemon, and least of the orange. However, it was not difficult to find orange-trees as early as December bearing a ripening crop of fruit intermingled with sprays of the famous fragrant flowers. The most impressive floral display was in the almond-orchards, where, rising from the dry, cleanly-kept soil, there were thousands of peach-like trees in straight rows, still without leaves, but in full bloom. The whole area was one vast sea of pink or peach-color, and the January air was full of the humming bees and lazy butterflies which were here finding so much to eat that life seemed almost a burden to them. As with some other species then in bloom, the almond-trees had been encouraged by the dry, warm winter, and had blossomed earlier than usual. This is a dangerous event, for, should the subsequent weather be cold and wet, the fruits blight, and the crop is much injured.

The leading winter-flowering ornamental shrubs are the roses, of which enough in praise can not be said. The heliotropes have a wealth of bloom, and a fragrance that scents the whole air. Geraniums (*Pelargoniums*) cover the sides of houses, and display a blaze of scarlet flowers. When water is supplied, the whole list of garden-flowers may be obtained in midwinter. A circle of callas around a fountain or water-tank, with spathes a foot across and as white as newly fallen snow, was no uncommon sight. But this paper deals only with the plants that grow without irrigation and bloom from the dust.

We remained long enough after the first rains fell to see the foothills begin to grow green, and were confidently informed that in a short time the warm days would quicken all vegetation into new life, and, in place of a few straggling plants, the whole face of the country would be covered with a variety of flowers more to be associated with fairy-land than anything on earth. However this may be, there are enough species which do not give up the struggle upon the approach of drought, so that, if a person is really bent upon finding blossoms, he may succeed, even though he wade through dust to get them.

THE Bishop of Bedford lately said, in a sermon, of evolution, that we had read our Bibles wrongly before, and may be reading them wrongly now; and protested against a hasty denunciation of what might be proved to have at least some elements of truth in it, and against a contemptuous rejection of theories that we might some day accept freely and as not inconsistent with God's Word.

THE FAMILY-LIFE OF FISHES.

By KARL HENNINGS.

AMONG the nest-building fishes which inhabit German waters, the most interesting is the tiny "stickleback," whose life-history has been carefully studied. The home of this little animal is sometimes found in ditches, hanging among branches and twigs of plants; the nest is about the size of the average hand, and in structure and material bears a marked resemblance to the round nest of the titmouse. It is a peculiar and remarkable fact that among the sticklebacks the hatching is done by the male and not by the female fish. The building of the nest, a task to which the male also attends, is an interesting event. For many days in succession the little animal, whose energy and perseverance are truly worthy of admiration, collects its material, which consists of loose stalks, plant-shreds, root-fibers, and grass. These it assorts carefully, discarding all material that proves too light. It often drags along pieces exceeding its body in length, and sometimes with great exertion strips growing plants. All this material is worked up into a tangled mass, and layers of sand are scattered in between. The nest is rendered firm by a glue-like juice, which the little mason excretes after the completion of each layer, gliding slowly over the structure; this causes the separate parts of the nest to adhere closely together. The whole, when completed, has the appearance of a sand-hill, and is detected with much difficulty. While at work the fish rarely partakes of any food; it seems that during this blissful period of its existence it finds no pleasure in such every-day events; but with intense animosity it drives back any jealous rivals, larvæ, salamanders, or water-bugs, which cross its path, sometimes with evil sometimes with harmless intentions. After the troublesome hatching-time is over, the anxious papa still continues to care for his numerous offspring; by day and by night he watches over them, and drives away all creatures whose approach seems dangerous. This unremitting watchfulness ceases only when his young are able to raise their weapons of defense and have become somewhat acquainted with their surroundings. Any inquisitive little one venturing too far away is quickly sent home, and it actually happens that those who are very disobedient are imprisoned in the nest. The home-life of these little animals really presents an abundance of interesting and touching traits.

To study the family of fishes which inhabit the ocean and sea-gulfs is naturally more difficult, and rarely proves as successful as observation extended to the inhabitants of our fresh-water lakes, rivers, and streams; but, by the co-operation of naturalists, fishermen, and sailors, many events happening in the deep seas have been observed that afford

a further insight into the life and the habits of fishes. In former times fishes were considered mute, impassive, and possessed of but little intelligence; nowadays we know that in these respects they can claim to rank as equals with many inhabitants of *terra firma*. A case in view is the *Cyclopterus lumpus*. This fish shows a decided attachment to its young, and is often seen with numerous little ones, of which it takes the best possible care. It is found chiefly near England's

FIG. 1.—*Cyclopterus lumpus*, THE LUMPFISH, WITH ITS YOUNG.

shores, and along the coast of Maine in America. The Cyclopterus has a peculiar form; its body displays many spots, swellings, and lumps which are partially arranged in regular order. It is, generally speaking, not a dangerous creature, never doing harm to any of its fellow-fish. It is defenseless and harmless, and on account of its unwieldy shape moves awkwardly and comparatively slowly. The only weapon this animal really possesses is its extreme ugliness, its uncouth form, which frightens its enemies and not infrequently scares them away. The young of the Cyclopterus follow their mother as little chicks are wont to follow a hen; they play and frolic about her, and are as obedient as little chicks are to the call of their mother. In case any strange object drifts nigh, or an enemy approaches, the whole

company, consisting often of several hundred little beings, crowd closely up to their protector. As already said, the Cyclopterus is but a poor swimmer, and it seems but natural to suppose that large waves should threaten danger, and that heavy breakers could easily hurl it on shore. But kind Nature has taken precautions. This curious inhabitant of the sea is capable of adhering so firmly to any object, rocks, drift-wood, or marine plants, that the most powerful waves can not tear it from its support. Its numerous slimy fins can be made to serve as a suction apparatus, so that its body, when thus fastened to a stone, appears like a ship riding at anchor. The Cyclopterus attains a length of about sixty centimetres, and varies in weight from three to four kilogrammes, sometimes even attaining a weight of six to seven kilogrammes. It can change its color from a yellow or a gray to black. Its progeny is remarkably numerous. Sometimes it is found in the Baltic Sea, but is seldom caught, on account of its peculiar mode of living. The adhesion of its body to the objects to which it has become fastened is so firm that a force of thirty-six kilogrammes is required to tear from its hold a Cyclopterus of about twenty centimetres in length. It has also been observed that this fish remains in one and the same place for weeks together, waiting until its food, which consists of sea-nettles and the smallest of fish, has come within convenient reach. Similar to the stickleback, the Cyclopterus faithfully guards its eggs, which always number hundreds of thousands, and proves very courageous in attacking dangerous enemies and heroically shielding its young. The male fish covers the eggs with his body, and retains this position until the little ones have made their appearance. These fishes are seldom taken by man; in Greenland and Iceland they are sometimes caught in nets, and when found among sea-plants they are speared with a prong-shaped iron. Their worst enemy is the seal, who seems to find them palatable food, although they must be skinned before they can be eaten.

Some species of *Ophiocephalus* present interesting features in their home-life. One variety which inhabits the Sea of Galilee, in Palestine, is known to seek shallow water during breeding-time. The parent fishes fasten small pieces of grass, leaves, sea-weeds, parts of shells, and small particles of wood, to a rock, or to the roots of an old tree, and weave the whole mass into an oval-shaped nest for their young; they arrange the stalks of grass so as to form a net-like cover, and then fill in the interstices with mud, taking care, however, to leave several openings. At the lower end they place an attachment, generally egg- or pear-shaped, which serves as a sort of cradle, being rocked to and fro by the swell of the waters. The eggs are deposited in the center, and stick to the grass and side-walls of the structure. After the lapse of but a short space of time the nest becomes crowded with tiny beings, which seem anxious to be set at liberty, but are carefully guarded by father and mother until they are capable of taking care

of themselves and facing the vicissitudes of life. Mutual attachment among the different members belonging to a family of this species seems to be a marked trait; it has often been observed that they protect their young by harboring them in their mouth whenever danger threatens. Even among the larger salt-water fishes, this manner of sheltering the brood is occasionally adopted. As an example may be cited a fish which the Chinese call *lau-lau*. It attains a length of

FIG. 2.—THE *Ophiocephalus* AND ITS BROOD.

thirteen feet and weighs over two hundred pounds. The same observation has been made with fishes whose home is in the lagoons of South America. The young fishes seem so accustomed to this place of refuge that, on perceiving any commotion in the water that seems in the least suspicious, they hasten *en masse* into the protecting mouth of their mother. Another fish, living near the coasts of South America, is known to fasten its young ones to its fins and body by means of a glue-like substance. This gives to these fishes the appearance of being covered with small protuberances.

On the coast of Guiana fishes have been found which dig their nests in miry shores, and live there much as sand-swallows do on land.

Another variety of the above-mentioned *Ophiocephalus*, a native of India, also makes its home in holes in the ground, and can remain in its nest for some time, even after the water has receded. These generally live together in couples. If the earth becomes too dry, they leave their houses and creep along for quite a distance on the damp ground. The lower classes of natives, whenever they see them engaged in such pilgrimages, believe them to have fallen from the sky.

Indian jugglers often keep these fishes in order to let them crawl about on land, and have the people enjoy the wonderful spectacle. Another fish, living in the Gulf of Panama, resembles the kangaroo, inasmuch as it possesses a bag-like receptacle in which it bears its eggs.

The most peculiar, however, of all fishes is the sea-horse (*Hippocampus*), remarkable on account of its queer shape as well as on account of its strange homestead and habits of life. With their numerous joints and their circular tail, these fishes have more the appearance of a plant than of an animal. While swimming they keep in an upright position, holding their tail in readiness for the peculiar use to which they put it. Very quickly they coil it around sea-weeds, and then carefully watch the surrounding water, on the lookout for booty, which, when perceived, they pursue with great dispatch. It sometimes happens that, when two of these fishes meet, they encircle each other with their tails, and they often have a hard time of it before they can again separate. By the peculiar growth of a part of the epidermis on the sea-horse a perfect pocket is formed, in which their eggs are allowed to develop.

FIG. 8.—THE *Hippocampus* AND ITS FAMILY.

Yet another kind of fish possesses a form still more weird, and may, on account of its shape and color, be easily mistaken for floating sea-weeds. And in this peculiar resemblance lies its greatest safeguard. In like manner the sea-needle greatly resembles the sea-plants among which it lives, not only in form, but also in color, which it can easily change from a gray or brown to a bluish or greenish hue.—*Translated for the Popular Science Monthly from Daheim.*

THE report of the British Royal Commission of 1886, on the depression of trade, while it failed to find any single positive cause or sovereign remedy for the stringency of the situation, presented overwhelming evidence that protection, instead of helping the countries where it prevailed, had hurt them. The silk-weavers of Macclesfield asked for protection against those of Lyons and Paterson, when it was shown that the Lyons weavers with protection were suffering far more terribly than their English competitors without it; and even the Macclesfield weavers, when it came to talking of protection on the provisions they consumed, did not think the rule would work well in that direction.

A PAPER OF CANDY.

By WILLIAM SLOANE KENNEDY.

FULLY to set forth the changes undergone by a cupful of cane-juice during its conversion, first into a cube of white sugar and then into a musk-lozenge or a lemon-drop, would require volumes. And even then one could not give a complete account of candy-making, for the reason that each skilled confectioner of hand-made candies has—like a painter or sculptor—his own incommunicable touch and methods. Yet a few words will suffice to give a general outline of the toothsome art.

We get our word "candy," not from the Cingalese city of that name, but from the Arabian *quand*, meaning sugar. Now, sugar is the crystallized juice of one of the gigantic grasses; candy, therefore, is only boiled grass-juice. As the bee collects from its two and a half million plants the nectar for its pound of honey, so man—a kind of giant bee—extracts from various plants their delicious liquors, which he afterward turns by his art into that sweet and shining sand called sugar. It was the ancients who called the crystals of sugar sweet sand and gravel—the Sanskrit word *çarkara* (our sugar) meaning gravel. Sugar is made in small quantities, it is true, from the palm-tree, the sorghum-cane, beets, California watermelons, potato-starch, and milk; yet the only kind that is used for the best candies is the clear juice of the Chinese cane, that tall and beautiful purple-striped and straw-colored plant of Malabar, Assam, Otaheite, Louisiana, and the West Indies, which even more than our *mondamin*, or tasseled maize, deserves the honor of poetical legends and myths.

The sugar-cane, like the domestic fowl, has taken two thousand years to make the circuit of the globe, always faithfully following man along a certain latitude in his westward migrations. From China or Bengal to Persia, Arabia, Spain, Madeira, Cuba, Louisiana, California—such has been its route, until now, facing westward, it may nod a welcome across the great Pacific to the shores of its old home in China and the East Indies.

In the making of candy some "raw" or brown sugar is taken (the best coming from the West Indies), but for the bulk of confections only refined sugar is used. Sugar may be clarified in small quantities by the white of eggs; in the plantation sugar-houses it is refined by lime or lime-water; but, in the great refineries, bone-black or animal charcoal is now used for this purpose, bullock's blood being discarded. When blood was used, its coagulation collected the impurities, which were then skimmed off, together with the coagulated blood. The reason of the immense height to which these refineries are built is that the liquid sugar, having once been raised to the highest story, may, in

its succeeding treatment, which consists chiefly of a series of filtrations (through cloth bags and bone-black), pass down from story to story by its own gravity. After the liquor has been passed through charcoal it is boiled to evaporate the water, then crystallized, the molasses or "sugar-drip" drained off, and the residuum of sugar dried in a centrifugal machine.

The philosophy of the action of heat on boiling sugar and water is by all odds the most curious and important matter connected with the making of confections. Put a little water and crushed sugar into a clean brass kettle, and note the changes which ensue when it is placed over a brisk fire. First, when the sugar is dissolved, we have what is called "simple sirup"; continue the boiling a little longer, and the liquor, if cooled, will deposit its excess of sugar on the sides and bottom of the vessel in the form of rock-candy; boil a little longer, and the sugar shows an inclination for the granular condition; longer still, and it forms a thick, pasty, transparent mass; longer yet, and it "caramels," or turns yellow and then brown. This whole series of processes, or states, is technically divided by the confectioner into nine degrees, which form his nine mysteries, his nine points of the law. These degrees are styled the "small thread" and "large thread," the "little pearl" and "large pearl," the "blow," the "feather," the "ball," the "crack," and the "caramel," all of which are produced by a heat ranging from 230° to 260° Fahr. In the thread degree the sugar threads or strings when held up in the air by the fingers; the blow is so called from the workman dipping his skimmer into the liquor, draining it, and then blowing through the holes; if small, sparkling bubbles are seen on the farther side of the skimmer, the sirup is known to be in the "blow" degree; when in the "feather," the sirup hangs from the skimmer like flying floss, and is then said by the French to be "*à la grande plume*"—it is the point of crystallization; in the "ball" degree it makes hard balls when rolled between the fingers; in the "crack" it snaps like a clay pipe-stem—it now tends to grain; the ninth or caramel degree was discovered, or first intelligently noted, by Count Albufage Caramel, of Nismes. The greater part of our candies are made from sirup which has passed the eighth or crack degree (250° Fahr.), and the skill of the artist is shown in bringing his sirup as near as he possibly can to the caramel (260° Fahr.) without permitting it actually to reach that undesirable point; for, when sirup begins to caramel, it becomes quickly dark-colored, froths up and fills the kettle, emits puffs of smoke, and acquires a bitter taste: the sugar is then called "burnt sugar," although it is not really burned.

But it is high time we saw the magician at work. His manufacturing-room may look a little like an alchemist's den, if you choose. Here are large coppered kettles, full of steaming sirup; there, men are at work picking up Malaga grapes with a fine pair of nippers and dipping them into creamed sugar; at yonder table one is cutting up a

pile of candied figs, and a pile of preserved cherries lies beside him; while still another is sugar-coating almonds in an oscillating kettle. In the middle of the room are low tables covered with marble slabs, on one of which an operator will perhaps be working out stick candy, and on another you may see long, shallow canals, or rivers, of congealing peanut or molasses candy, confined on the slab by long, solid iron bars. Scattered around are the workmen's simple tools — spatulas, strainers, molds, paste, syringes, and the like. The materials of the candy-maker are equally simple and few, consisting in the main of only three kinds of articles—sugar, flavorings, and colors. The flavors usually employed are the essential oils of various aromatic plants. Mixed with spirits these oils form extracts and essences, the extract being a stronger flavoring than the essence. The extracts of lemon, wintergreen, peppermint, clove, cinnamon, vanilla, and ginger, are used in great quantities. Extract of lemon is best prepared fresh by grating the rinds of lemons either with a grater or with cubical lumps of hard sugar, the operator being careful not to get down to the bitter white portion which underlies the outer yellow skin. As to the vanilla vine, the best Mexican pods will, if macerated in alcohol, give a fresher flavor than that of the bottled extract. The colors employed by reputable confectioners are nearly all purely vegetable, and are quite harmless. They are such as cochineal, carmine, saffron, Prussian blue* (a preparation of iron), and the like. For brown, caramel is used, and mixed with carmine it forms orange-yellow. To convince one's self of the harmlessness of these colors, one only needs to know that a bit of red coloring-matter the size of a gum-drop will color five thousand pounds of candy. Cheap candies colored with poisonous mineral stuffs are annually seized by the New York city health officers. Many French candies used to be colored not only with such disagreeable earths as umber and sienna, but with red lead, chrome-yellow, and vermilion, all of which are highly poisonous. French confectioners have now, however, not only formed themselves into a national association to protect themselves against unprincipled manufacturers, but they themselves are strictly supervised, being allowed by their government to use only the following harmless colorings: *Blues*—indigo, Prussian blue, ultramarine; *reds*—cochineal, carmine, carmine lake; *yellows*—saffron, French berries, and turmeric or fustic; *greens*—mixture of above yellows and blues; *purples*—mixture of red and blue. Cheap candies are not only often poisonous, but badly adulterated with terra alba, corn-starch, and starch-sugar or glucose. Cheap gum-drops are made from corn-starch, to which ordinary glue is sometimes added; whereas the best gum-drops are made from gum arabic and cane-sugar. Stick-candy made from glucose may be detected by its lack of sweet-

* [Prussian blue is not a vegetable color, and can not be correctly regarded as "quite harmless." In Battershall's "Food Adulteration and its Detection" it is classed, as a coloring for confectionery, among pigments of a "very objectionable character."—EDITOR.]

ness, its yellowish color, and its extreme frangibility. The nuts and fruits used in the cheaper varieties are also of poor quality, being mostly worm-eaten, old, or damaged.

To return now to our boiled sugar, which we left in the half-cooled pasty or doughy condition produced by 250° of heat. A mass of sugar in this state is the common or basic material of all candies; it is the nodal point of the line, the focus of all the processes. Antecedent to this lump of waxy paste lies a field of waving, tasseled cane, and forth from said lump proceed the thousand fantastic and toothsome dainties that glow in the golden trays of the confectioner's window.

The candy is worked by placing it on a marble slab kept warm perhaps by steam (sometimes an iron plate at one end is kept heated), and having movable iron bars for sides and ends—like the chase with which a printer's "form" is surrounded. When cool enough to handle, the flavor and the coloring ingredients are worked in. Clear candies are run into pans or trays without being kneaded or pulled; but if a white opaque article is desired, the mass is *pulled* on a hook similar to those seen in butchers' stalls—pulled out, folded, and thrown back over the hook, and again pulled until it assumes a sufficiently white appearance. For stick-candy "A" sugar is used, boiled down with a little cream of tartar to prevent crystallization. The striping of sticks is a very curious thing to see. The operator takes from the warm mass of candy a portion which he colors as desired, then draws it out into long, coarse strips, pressing them into the main mass, which is then rolled into a cylindrical shape, and gradually tapered out smaller and smaller until it is of the diameter of a stick of candy; the mass then resembles somewhat a balloon laid on its side, with its drag-rope extended on the ground beside it. Now, the colored stripes (having been rolled up in the paste) have been drawn out with the rest and in proper proportion, so that they appear both in the inside and on the outside of the stick as stripes. Sometimes a slight twist is given to the long stick before it is cut by the scissors to the required lengths. The working of candy by kneading or pulling it on the hook separates the particles and increases the bulk, so that the youngster who buys a stick of white candy imagines wrongly that he is getting more for his penny than if he had invested in a clear stick.

Lemon and other drops are now made by machines, which consist of two revolving cylinders, with holes on each side so arranged as to come exactly opposite each other when the cylinders revolve; the movement of the cylinders forces the candy into these molds.

The flat, striated cream-sticks of the shops are made simply by working the candy very thoroughly until it acquires the creamy texture. Peppermint-drops are made of granulated sugar and water heated to the boiling-point (but not actually boiled), and afterward flavored with the essence. White molasses candy is made of "coffee C" sugar, mixed with equal proportions of sugar-house and New Orleans molasses, and

a little carbonate of soda; if this candy is poured into trays without working, it forms a fine, plain taffy. Nearly all cough-candies are made of boiled brown sugar, flavored or medicated with anise, camphor, cayenne pepper, and peppermint, in varying proportions. The medicated lozenges, known under the name of troches, pastilles, and pulmonic wafers, contain substances possessing demulcent, sedative, tonic, and often slightly astringent properties. Most bronchial troches are composed of extract of liquorice, sugar, gum arabic, powdered cubebs, and extract of conium.

The delicious cream bonbons, of which the most popular variety is the chocolate cream, form a group by themselves. The materials used are the best loaf or crushed sugar, water, with a little acetic acid or cream of tartar, the whole boiled to the thread degree. The creaming of the mixture, so that it melts in the mouth, is produced by rubbing it back and forth on the marble slab or against the sides of the kettle with a wooden spatula or spoon. Sugar in this state is called *fondant* by confectioners. Owing to the peculiar granular texture of the creamed sugar, it can not be cast in ordinary molds without breaking; hence the use of finely-powdered starch for molds. Plaster models of the shape desired are fastened at regular distances from each other on a flat slab, and when pressed into a tray of the starch-flour produce cavities into which the creamed sugar is then run. The starch easily separates from the bonbons when they are cool, just as the earth mold falls away from the finished iron casting. The candies are also generally shaken in a sieve to remove the starch-particles that may still adhere. If it is wished to crystallize them, they are submerged for ten or twelve hours in properly boiled sugar, with a small portion of alcohol added; when removed they will be covered with sparkling crystals. The chocolate on the outside of chocolate creams is applied by simply rolling the cream-balls in thick fluid chocolate. The chocolate is prepared by grinding it on a hot plate or bed, the heat of which melts the oil in the substance and keeps it in a fluid condition.

Children are often mystified by brandy and wine gum-drops and other *liqueur* drops. The mystery is easily penetrated. The boiled sugar is simply mixed with the brandy or flavored water, and the whole poured into starch molds. As the sirup cools on the top and the sides, the sugar crystallizes around the liquor, leaving it safely prisoned within. So, in the case of pure gum-drops not containing liquor, the evaporation of water from the surface of the gum arabic forms a hard crust, which prevents the further evaporation of the interior liquid, for a long time at least. The delicate little aromatic disks known as white lozenges are also made of gum arabic, which is mixed with dry, powdery icing-sugar, the mass then flavored, rolled flat with a wooden roller, and cut into shape with a tin cutter. In this case the sugar is not even heated or mixed with water at all. Sugar-

coated confections, such as sugared almonds, pistachios, and perfumed cherry-kernels, are now generally made on a large scale by machinery, as follows: The almonds, we will say, are placed in spherical copper pans over a hot fire, and a heavy sirup allowed slowly to drip over them. The pans are heated by steam passing through coils of pipe, and are kept in continual oscillation; the water of the sirup quickly flies off in vapor, leaving the almonds covered with crystals of sugar.

The fruit-pastes sold at candy-shops are prepared by reducing the fruit—be it peach, orange, or quince—to a kind of marmalade, mixed with the exact amount of sugar required. The roots of the marsh-mallow are not often used nowadays in the compounding of the popular paste of that name. This is owing to the unpleasant taste of the roots. The juice or jelly of the apple is employed instead. The other ingredients are gum arabic, the beaten whites of eggs, and flavoring—the whole thickly dusted with powdered starch.

Chocolate caramels are made of gelatin, dairy cream, sugar, and chocolate. The delicate molasses chips made for fastidious consumers of confections are compounded of sugar and a little molasses for flavor; their brittleness is simply due to the fact that the sirup is boiled to the brittle or "crack" degree.

THE EARLIEST PLANTS.*

By Sir WILLIAM DAWSON.

THE knowledge of fossil plants and of the history of the vegetable kingdom has, until recently, been so fragmentary that it seemed hopeless to attempt a detailed treatment of the subject. Our stores of knowledge have, however, been rapidly accumulating in recent years, and we have now arrived at a stage when every new discovery serves to render useful and intelligible a vast number of facts previously fragmentary and of uncertain import.

Oldest of all the formations known to geologists, and representing perhaps the earliest rocks produced after our earth had ceased to be a molten mass, are the hard, crystalline, and much-contorted rocks named by the late Sir W. E. Logan Laurentian, and which are largely developed in the northern parts of North America and Europe, and in many other regions. So numerous and extensive, indeed, are the exposures of these rocks, that we have good reason to believe that they underlie all the other formations of our continents, and are even world-wide in their distribution. In the lower part of this great system of rocks, which, in some places at least, is thirty thousand feet in thickness, we find no traces of the existence of any living thing on the

* From the "Geological History of Plants," published by D. Appleton & Co., "International Scientific Series," vol. lxi.

earth. But, in the middle portion of the Laurentian, rocks are found which indicate that there were already land and water, and that the waters and possibly the land were already tenanted by living beings. The great beds of limestone which exist in this part of the system furnish one indication of this. In the later geological formations the limestones are mostly organic—that is, they consist of accumulated remains of shells, corals, and other hard parts of marine animals, which are composed of calcium carbonate, which the animals obtain directly from their food, and indirectly from the calcareous matter dissolved in the sea-water. In like manner great beds of iron-ore exist in the Laurentian; but in later formations the determining cause of the accumulation of such beds is the partial deoxidation and solution of the peroxide of iron by the agency of organic matter. Besides this, certain forms known as *Eozoon Canadense* have been recognized in the Laurentian limestones, which indicate the presence at least of one of the lower types of marine animals. Where animal life is, we may fairly infer the existence of vegetable life as well, since the plant is the only producer of food for the animal. But we are not left merely to this inference. Great quantities of carbon or charcoal in the form of the substance known as graphite or plumbago exist in the Laurentian. Now, in more recent formations we have deposits of coal and bituminous matter, and we know that these have arisen from the accumulation and slow putrefaction of masses of vegetable matter. Further, in places where igneous action has affected the beds, we find that ordinary coal has been changed into anthracite and graphite, that bituminous shales have been converted into graphitic shales, and that cracks filled with soft bituminous matter have ultimately become changed into veins of graphite. When, therefore, we find in the Laurentian thick beds of graphite and beds of limestone charged with detached grains and crystals of this substance, and graphitic gneisses and schists and veins of graphite traversing the beds, we recognize the same phenomena that are apparent in later formations containing vegetable *débris*.

The carbon thus occurring in the Laurentian is not to be regarded as exceptional or rare, but is widely distributed and of large amount. In Canada more especially the deposits are very considerable.

The graphite of the Laurentian of Canada occurs both in beds and in veins, and in such a manner as to show that its origin and deposition are contemporaneous with those of the containing rock.

The quantity of graphite in the Lower Laurentian series is enormous. Some years ago, in the township of Buckingham, on the Ottawa River, I examined a band of limestone believed to be a continuation of that described by Sir W. E. Logan as the Green Lake limestone. It was estimated to amount, with some thin interstratified bands of gneiss, to a thickness of six hundred feet or more, and was found to be filled with disseminated crystals of graphite and veins of the min-

eral to such an extent as to constitute in some places one fourth of the whole; and, making every allowance for the poorer portions, this band can not contain in all a less vertical thickness of pure graphite than from twenty to thirty feet. In the adjoining township of Lochaber Sir W. E. Logan notices a band from twenty-five to thirty feet thick, reticulated with graphite veins to such an extent as to be mined with profit for the mineral. At another place in the same district a bed of graphite from ten to twelve feet thick, and yielding twenty per cent. of the pure material, is worked. As it appears in the excavation made by the quarrymen, it resembled a bed of coal; and a block from this bed, about four feet thick, was a prominent object in the Canadian department of the Colonial Exhibition of 1886. When it is considered that graphite occurs in similar abundance at several other horizons, in beds of limestone which have been ascertained by Sir W. E. Logan to have an aggregate thickness of thirty-five hundred feet, it is scarcely an exaggeration to maintain that the quantity of carbon in the Laurentian is equal to that in similar areas of the Carboniferous system.

If we ask more particularly what kinds of plants might be expected to be introduced in such circumstances, we may obtain some information from the vegetation of the succeeding Palæozoic age, when such conditions still continued to a modified extent. In this period the club-mosses, ferns, and mare's-tails engrossed the world and grew to sizes and attained degrees of complexity of structure not known in modern times. In the previous Laurentian age something similar may have happened to algæ, to fungi, to lichens, to liverworts, and mosses. The algæ may have attained to gigantic dimensions, and may have even ascended out of the water in some of their forms.

Whether this early Laurentian vegetation was the means of sustaining any animal life other than marine protozoa, we do not know.

If we ask to what extent the carbon extracted from the atmosphere and stored up in the earth has been, or is likely to be, useful to man, the answer must be that it is not in a state to enable it to be used as mineral fuel. It has, however, important uses in the arts, though at present the supply seems rather in excess of the demand, and it may well be that there are uses of graphite still undiscovered, and to which it will yet be applied.

Finally, it is deserving of notice that, if Laurentian graphite indicates vegetable life, it indicates this in vast profusion. That incalculable quantities of vegetable matter have been oxidized and have disappeared we may believe on the evidence of the vast beds of iron-ore; and, in regard to that preserved as graphite, it is certain that every inch of that mineral must indicate many feet of crude vegetable matter.

It is remarkable that, in ascending from the Laurentian, we do not at first appear to advance in evidences of plant-life. The Huronian age, which succeeded the Laurentian, seems to have been a disturbed

and unquiet time, and, except in certain bands of iron-ore and some dark slates colored with carbonaceous matter, we find in it no evidence of vegetation. In the Cambrian a great subsidence of our continents began, which went on, though with local intermissions and reversals, all through the Siluro-Cambrian or Ordovician time. These times were, for this reason, remarkable for the great abundance and increase of marine animals rather than of land-plants. Still, there are some traces of land vegetation.

The oldest plants known to me, and likely to have been of higher grade than algæ, are specimens kindly presented to me by Dr. Alleyne Nicholson, of Aberdeen, and which he had named *Buthotrephis Harknessii** and *B. radiata*. They are from the Skiddaw rocks of Cumberland. On examining these specimens, and others subsequently collected in the same locality by Dr. G. M. Dawson, while convinced by their form and carbonaceous character that they are really plants, I am inclined to refer them not to algæ, but probably to rhizocarps. They consist of slender branching stems, with whorls of elongate and pointed leaves, resembling the genus *Annularia* of the coal formation. I am inclined to believe that both of Nicholson's species are parts of one plant, and for this I have proposed the generic name *Protannularia* (Fig. 1). Somewhat higher in the Siluro-Cambrian, in the Cincinnati group of America, Lesquereux has found some minute radiated leaves, referred by him to the genus *Sphenophyllum*, which is also allied to rhizocarps. Still more remarkable is the discovery in the same beds of a stem with rhombic areoles or leaf-bases, to which the name *Protostigma* has been given.† If a plant, this may have been allied to the club-mosses. This seems to be all that we at present know of land-vegetation in the Siluro-Cambrian. So far as the remains go, they indicate the presence of the families of rhizocarps and of lycopods.

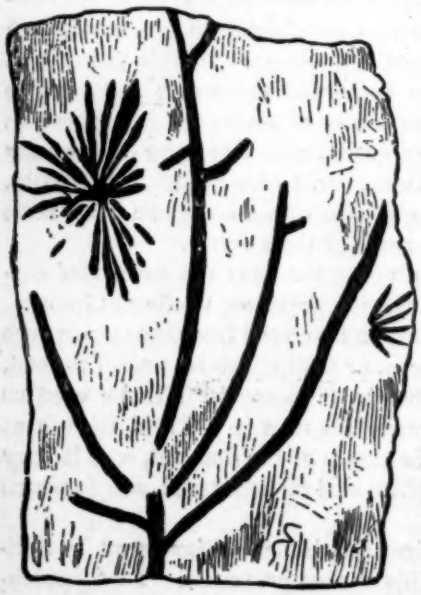


FIG. 1.—*Protannularia Harknessii* (Nicholson), a probable Rhizocarp of the Ordovician period.

If we ascend into the Upper Silurian, or Silurian proper, the evidences of land-vegetation somewhat increase. In 1859 I described, in The "Journal of the Geological Society," of London, a remarkable tree from the Lower Erian of Gaspé, under the name *Prototaxites*, but

* "Geological Magazine," 1869. † *Protostigma sigillarioides*, Lesquereux.

for which I now prefer the name *Nematophyton*. When in London, in 1870, I obtained permission to examine certain specimens of sporecases or seeds from the Upper Ludlow (Silurian) formation of England, and which had been described by Sir Joseph Hooker under the name *Pachytheca*. In the same slabs with these I found fragments of

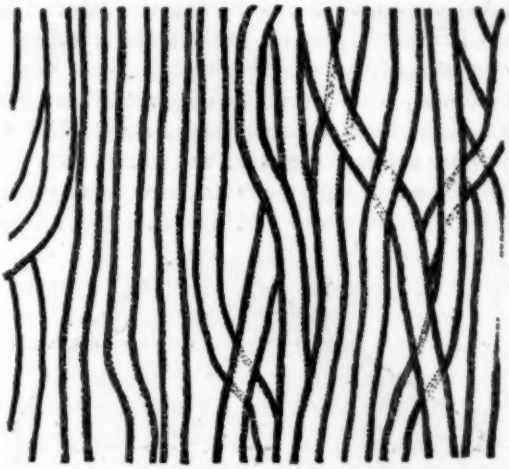


FIG. 2.—*Nematophyton Logani* (magnified). Vertical section.

fossil wood identical with those of the Gaspé plant. Still later I recognized similar fragments associated also with *Pachytheca* in the Silurian of Cape Bon Ami, New Brunswick. Lastly, Dr. Hicks has discovered similar wood, and also similar fruits, in the Denbighshire grits, at the base of the Silurian.*

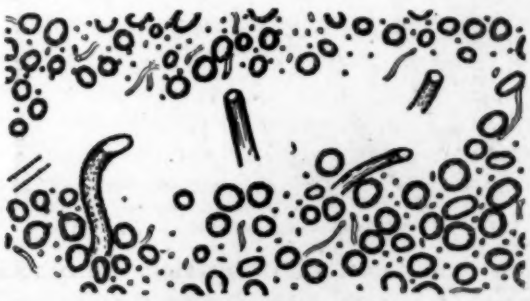


FIG. 3.—*Nematophyton Logani* (magnified). Horizontal section, showing part of one of the radial spaces, with tubes passing into it.

They are trees of large size, with a coaly bark and large spreading roots, having the surface of the stem smooth or irregularly ribbed, but with a nodose or jointed appearance. Internally, they show a tissue of long, cylindrical tubes, traversed by a complex network of horizontal tubes thinner walled and of smaller size. The tubes are ar-

* "Journal of the Geological Society," August, 1881.

ranged in concentric zones, which, if annual rings, would in some specimens indicate an age of one hundred and fifty years. There are also radiating spaces, which I was at first disposed to regard as true medullary rays, or which at least indicate a radiating arrangement of the tissue. They now seem to be spaces extending from the center toward the circumference of the stem, and to have contained bundles of tubes gathered from the general tissue and extending outward perhaps to organs or appendages on the surface. That the plant grew on land I can not doubt, from its mode of occurrence; that it was of durable and resisting character is shown by its state of preservation; and the structure of the seeds called *Pachytheca*, with their constant association with these trees, give countenance to the belief that they are the fruit of *Nematophyton*. Of the foliage or fronds of these

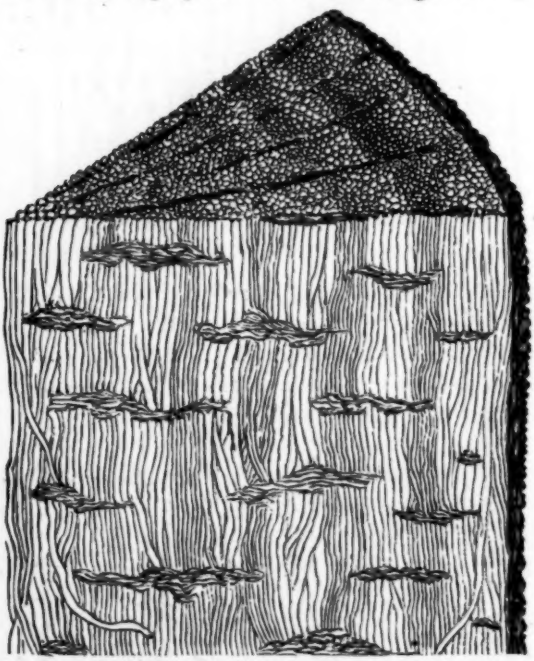


FIG. 4.—*Nematophyton Logani* (magnified). Restoration.*

strange plants we unfortunately know nothing. They seem, however, to realize the idea of arboreal plants having structures akin to those of thallophytes, but with seeds so large and complex that they can scarcely be regarded as mere spores.

Multitudes of markings occurring on the surfaces of the older rocks have been referred to the algæ or sea-weeds, and indeed this group has been a sort of refuge for the destitute to which paleontologists have been accustomed to refer any anomalous or inexplicable form which, while probably organic, could not be definitely referred

* Figs. 2, 3, and 4 are drawn from nature, by Professor Penhallow, of McGill College.

to the animal kingdom. There can be no question that some of these are truly marine plants; and that plants of this kind occur in formations older than those in which we first find land-plants, and that they have continued to inhabit the sea down to the present time. It is also true that the oldest of these algæ closely resemble in form plants of this kind still existing; and, since their simple cellular structures and soft tissues are scarcely ever preserved, their general forms are all that we can know, so that their exact resemblance to or difference from modern types can rarely be determined. For the same reasons it has proved difficult clearly to distinguish them from mere inorganic markings or the traces of animals, and the greatest divergence of opinion has occurred in recent times on these subjects.

The author of this work has given much attention to these remains, and has not been disposed to claim for the vegetable kingdom so many of them as some of his contemporaries.* I believe there are many real examples of fossil algæ, but the difficulty is to distinguish them.

The genus *Buthotrephis* of Hall, which is characterized as having stems, subcylindric or compressed, with numerous branches, which are divaricating and sometimes leaf-like, contains some true algæ. A beautiful species, collected by Colonel Grant, of Hamilton, and now in the McGill College collection, may be described as follows:

Fig. 5.—*Buthotrephis Grantii*, a genuine Alga from the Silurian, Canada.

Buthotrephis Grantii, S. N. (Fig. 5). — Stems and fronds smooth and slightly striate longitudinally, with curved and interrupted striæ. Stem thick, bifurcating, the divisions terminating in irregularly pinnate fronds, apparently truncate at the extremities. The quantity of carbonaceous matter present would indicate thick, though perhaps flattened, stems and dense fleshy fronds.

It may be well to mention the remarkable Cauda-Galli fucoids, referred by Hall to the genus *Spirophyton*, and which are characteris-

* "Impressions and Footprints of Aquatic Animals," "American Journal of Science," 1873.

tic of the oldest Erian beds. The specimens which I have seen from New York, from Gaspé, and from Brazil, leave no doubt in my mind that these were really marine plants, and that the form of a spiral frond, assigned to them by Hall, is perfectly correct. They must have been very abundant and very graceful plants of the early Erian, immediately after the close of the Silurian period.

It is not surprising that great difficulties have occurred in the determination of fossil algæ. Enough, however, remains certain to prove that the old Cambrian and Silurian seas were tenanted with seaweeds not very dissimilar from those of the present time. It is further probable that some of the graphitic, carbonaceous, and bituminous

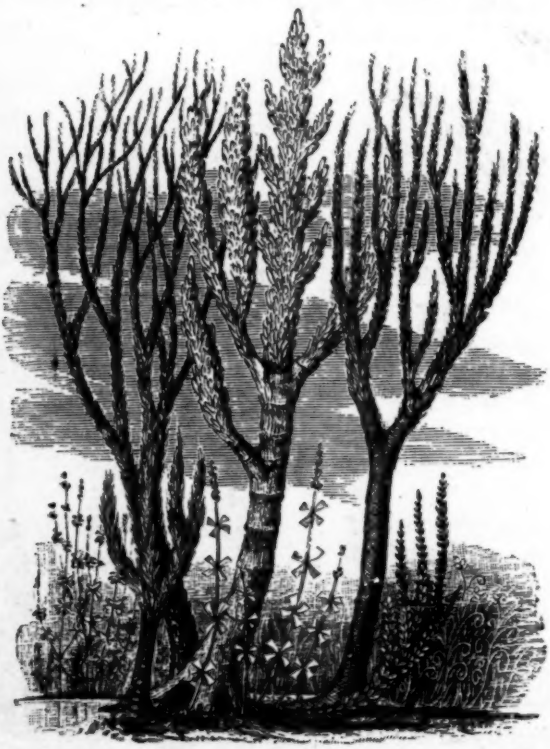


FIG. 6.—SILURIAN VEGETATION RESTORED. *Protannularia, Berwynia, Nematophyton, Sphenophyllum, Arthrostigma, Pollophyton.*

shales and limestones of the Silurian owe their carbonaceous matters to the decomposition of algæ, though possibly some of it may have been derived from graptolites and other corneous zoöphytes. In any case, such microscopic examinations of these shales as I have made, have not produced any evidence of the existence of plants of higher grade, while those of the Erian and Carboniferous periods, similar to the naked eye, abound in such evidence. It is also to be observed that, on the surfaces of beds of sandstone in the Upper Cambrian,

carbonaceous *débris*, which seems to be the remains of either aquatic or land plants, is locally not infrequent.

Referring to the land vegetation of the older rocks, it is difficult to picture its nature and appearance. We may imagine the shallow waters filled with aquatic or amphibious rhizocarpean plants, vast meadows or brakes of the delicate *Psilophyton* and the starry *Protannularia* and some tall trees, perhaps looking like gigantic club-mosses, or possibly with broad, flabby leaves, mostly cellular in texture, and resembling algæ transferred to the air. Imagination can, however, scarcely realize this strange and grotesque vegetation, which, though possibly copious and luxuriant, must have been simple and monotonous in aspect, and, though it must have produced spores and seeds and even fruits, these were probably all of the types seen in the modern acrogens and gymnosperms.

> "In garments green, indistinct in the twilight,
> They stand like Druids of old, with voices sad and prophetic."

Prophetic they truly were of the more varied forests of succeeding times, and they may also help us to realize the aspect of that still older vegetation, which is fossilized in the Laurentian graphite; though it is not impossible that this last may have been of higher and more varied types, and that the Cambrian and Silurian may have been times of depression in the vegetable world, as they certainly were in the submergence of much of the land.

These primeval woods served at least to clothe the nakedness of the new-born land, and they may have sheltered and nourished forms of land-life still unknown to us, as we find as yet only a few insects and scorpions in the Silurian. They possibly also served to abstract from the atmosphere some portion of its superabundant carbonic acid harmful to animal life, and they stored up supplies of graphite, of petroleum, and of illuminating gas, useful to man at the present day. We may write of them and draw their forms with the carbon which they themselves supplied.

THE considerations adduced by Professor Alfred Marshall, in answer to the question whether London is healthy, are applicable to other large cities. Many people live long in the metropolis, not because it is healthy, but because their exceptional health and strength induced them to come there. Most of the inhabitants who were born elsewhere were, when they came, the picked lives, the strongest members of their several parishes. Numbers of London-born people have gone away to live elsewhere because they felt themselves unequal to the strain of metropolitan life. The death-rate of young women is low, partly because of the favorable conditions of life of domestic servants, and partly because young people who come to the city are likely to go home as soon as they get ill, to swell, perhaps, the death-rate of their native towns. Really, London is very unhealthy; for, although the population consists mainly of picked lives, and despite all the resources of wealth to counteract disease, the expectation of life is below the average.

CHINESE SUPERSTITIONS.

By ADÈLE M. FIELDE.

THE superstitious beliefs and observances of the Chinese are numberless, and they occupy more or less the time and mind of every individual in the nation. Those here recorded are common among the people near Swatow. I am unable to say how many of them are purely local.

When a child is just one month old, the mother, carrying it in a scarf on her back, induces it to look down into a well. This is supposed to have a mentally invigorating effect, producing courage, and deepening the understanding.

A mother feeds her young infant from a cup rather than from a bowl or plate, because a bowl, being capacious, has an occult influence in making the child a large eater; while a plate, being shallow, causes him to throw up his food on slight provocation. The cup, being small and deep, insures his taking but little food, and keeping it for assimilation.

When a child becomes ill, the mother gathers thorns from twelve species of plants and makes an infusion in which she washes the child, hoping to wash the disease, with the demon that produces it, into the water. She then carries the water to an open space where many people go to and fro, and there throws it upon the ground. As she goes from her own house, the inhabitants of the streets she traverses shut their doors, to prevent the disease from entering their abodes. A woman of my acquaintance recently told me that, having no fear of demons, she did not shut her door when a neighbor passed her house carrying water in which a child having fever and ague had just been washed, and the very next day she herself had chills!

If a child falls from a high place to the ground, spirit-money is immediately burned upon the spot by the mother, to propitiate the demon who is trying to pull the child down to destruction.

When a child has fallen, there is danger that he may have left his twelve wits in the earth on which he fell, so the mother at once makes with her empty hand the motion of dipping from the ground to the child's chest. Thus she replaces in the child what might otherwise be permanently lost in the soil. If a man falls into a cesspool or well, a long-handled dipper is used to dip out and restore to his bosom his scattered senses; then three sheets of spirit-money are thrown burning into the well, and a heavy stone is cast after it.

It is unlucky to leave much hair on a boy's head when he is old enough to wear a queue; therefore the head should be shaved so as to leave but a small patch on the crown. Abundant hair is symbolic of a burden on the head, and a heavy queue may soon bring the care of the family upon the boy through the death of his father.

During the month succeeding the birth of a child the mother must not cross the threshold of another person's room. Should she do this, she will endanger the welfare of the occupants, and in her next life she will perpetually scrub the floor of the room entered.

A girl who is partaking of the last meal she is to eat in her father's house previous to her marriage, sits at the table with her parents and brothers; but she must eat no more than half the bowl of rice set before her, else her departure will be followed by continual scarcity in the domicile she is leaving.

If a bride breaks the heel of her shoe in going from her father's to her husband's house, it is ominous of unhappiness in her new relations.

A piece of bacon and a parcel of sugar are hung on the back of a bride's sedan-chair as a sop to the demons who might molest her while on her journey. The "Three Baneful Ones" are fond of salt and spices, and the "White Tiger" likes sweets.

A bride may be brought home while a coffin is in her husband's house, but not within one hundred days after a coffin is carried out. Domestic troubles are sure to come upon one who is married within a hundred days after a funeral.

A bride, while putting on her wedding garments, stands in a round, shallow basket. This conduces to her leading a placid, well-rounded life in her future home. After her departure from her father's door, her mother puts the basket over the mouth of the oven, to stop the mouths of all who would make adverse comment on her daughter, and then sits down before the kitchen range, that her peace and leisure may be duplicated in her daughter's life.

A bride must not, for four months after her marriage, enter any house in which there has recently been a death or a birth, for if she does so there will surely be a quarrel between her and the groom. If a young mother goes to see a bride, the visitor is looked upon as the cause of any calamity that may follow.

One who has ordered a coffin must guide its bearers by the shortest road to the house in which the corpse lies. The bearers of an empty coffin may not inquire their way at any house nor of any person. To mistake the road when carrying a coffin, or to take it to any house other than that where it is wanted, brings terrible misfortunes on persons thereby disturbed. Any insult may with impunity be offered to coffin-sellers who mistake the destination of their goods.

One should not catch butterflies, since departed spirits frequently incorporate themselves in these insects, and flit back to see what is being done in their old dwelling. A man is known to have died the day after killing a butterfly.

When a cow's tooth is found in a field, it is put on a shelf with the gods, and keeps demons from entering the house.

If, when one is under the open sky, a bird drops excrement upon one, the omen is bad, and must be immediately offset by going to per-

sons of three different surnames, all unlike one's own, and begging a little rice to eat.

If one, who is walking along a road, has a sudden attack of colic, he procures three paper bags that have held incense, and burns them on the spot where he was when he began to feel the pain, to pacify the demon of the locality. A demon's day is man's night, and man's night is a demon's day; therefore candles are lighted when offerings are made to demons by daylight.

If a fly falls into the porridge, if a magpie chatters on the roof, or if two chickens fight, it is a sign that a guest is coming.

A cock that crows before midnight foretells a death in the family. Spirit-money must be burned, a hoop must be put in the front door at its top, and the crowing fowl must be given away or sold. No one would knowingly buy a fowl that crowed before midnight, and, if it were sold, no one would dare use the cash received for it.

When a person commits suicide by hanging, the beam from which the body hung is cut out from the roof and burned, or thrown into the river to be carried away by the current. The floor underneath the feet of the hanging corpse is also dug up and replaced by new material. Thus the evil influence which would inhere in the spot is eradicated from the house.

If a pot of money is found, a rice-flour cake is put in the place of each coin taken, and spirit-money is burned as an offering to any spirit that might be irritated by the removal of the treasure.

No one picks up a girdle found in the road, through fear that some one may have been hung by it, and that the spirit may follow and worry the possessor. If a single coin or other article is found, it is picked up with fear; but if a pair or an even number of things be found, they are taken without anxiety, for odd numbers are unlucky, while even numbers are lucky. Three is a particularly unlucky number. Three persons, therefore, never sit together at a table, and no couple marries when there are six years of difference in age, because six is twice three.

It is not considered respectable for an old man to be without a beard, nor for a young man to wear one. A youth who puts on an air of wisdom is called a beardless old man. When a man decides to let his beard grow, his sons and sons-in-law make a feast for him, and congratulate him on his longevity. No one who has once grown a beard cuts it off, as such an act would inevitably bring disasters upon his family.

If one sneezes on New-Year's-eve while preparing for bed, he fears misfortune during the next year, unless he goes to three families of different surnames, and begs from each a little cake, shaped like a tortoise, and in common use at the end of the year as an emblem of long life. These cakes must be eaten by the sneezer before midnight.

Sneezing is generally a sign that somebody is thinking of one. A

man walking along the road knew that a stranger was walking behind him. The first man sneezed, and, though he was a bachelor, he liked to appear to be the head of a household, and exclaimed, "Ah, my wife is thinking of me!" The second man, on reaching home, asked his wife why she had not thought of him at all that day. The wife inquired why he asked that unusual question, and, after much persuasion, got him to reveal the reason for his unjust accusation of disregard. When he told her that he had not sneezed, while his fellow-traveler had received that proof of a wife's remembrance, the wise little woman told her jealous spouse that on the morrow he would have evidence of her consideration. The next morning he went to carry two jars of oil to a neighboring village, and, as the sun was hot, his wife urged his wearing a wet towel on his head under his hat to protect him from the heat. The towel was cold, and gave the poor man a chill. Just as he was going down a steep slope he sneezed violently, stumbled, fell, and spilled the oil. When he reached home that evening, he said to his wife, "If you are going to think of me when I am absent, I wish you would do it when I am on level ground, and not when I am going down-hill!"

THE PRESENT STATUS OF MINERALOGY.

By Professor F. W. CLARKE.

IN the study of any branch of science it is well to pause occasionally, that we may look about us, see where we are, what we are doing, and what we had better do. For that which distinguishes science from empirical knowledge is its unity of purpose, its coherence, and its definite relation of part to part; and these features develop best when attention is temporarily withdrawn from the details of special research. As a science grows, and increases in complexity, the individual worker must confine himself more and more to particular investigations; these, to him, assume undue importance, and their higher significance as part of a broad general field is ignored or lost. The petty details are essential; but, incoördinated, they make not science, but chaos. The scattered bricks are good material, but they must be brought together into one symmetrical structure.

These remarks are particularly true of a concrete science like mineralogy. Here we have a branch of knowledge which rests upon the observation of material facts; and which, hitherto, has owed little to abstract reasoning. It has grown up, partly as a "natural" science, partly as an outlying division of chemistry; and hypothesis has had little to do with its upbuilding. The mineralogist collects, observes, describes, and classifies species as he finds them, determines their mode of occurrence, chemical composition, and physical properties; and then, too often, considers his work finished, except as re-

gards the gathering of more data of like kind, with possible refinements of method. The relations and bearing of mineralogy toward other sciences have been, with rare exceptions, slighted; and a general theory of its nature and purpose has hardly been considered at all.

Of late years, however, an improvement has been noticeable. New lines of investigation are open, new modes of thought are recognized, and philosophical treatment is in order. In mineralogy, as in most other sciences, a central stem of growth is perceivable, around which the facts are grouping themselves to obvious advantage. Lithology (which mainly deals with the association of minerals), the study of pseudomorphs and alterations, and the synthesis of many mineral species, all furnish lines of evidence which converge toward certain general conceptions dominating the entire subject, and linking it intimately with other divisions of scientific thought. The discovery of new species is no longer the main object of the mineralogist, who is learning to look upon the correlation of known minerals as much more important.

In the study of minerals as such, apart from their geological relations, two main avenues of research are followed: First, the physical method, which is now mainly devoted to morphological considerations; and, secondly, the chemical method, which discusses composition. Philosophically regarded, the former method is subordinate to the latter, for physical properties, including form, are undoubtedly functions of chemical structure, which alone is fundamental and determining. A mineral species is best denoted as a definite chemical substance occurring in the crust of the earth; and its integrity depends upon the sharpness with which its constitution can be made out. In any given case, the claims of a species to recognition depend upon definiteness of composition, together with, in less degree, definiteness of form. The latter consideration, however, is only approximately general; for in some cases it can not be determined, and some minerals are amorphous; whereas the former test applies without exception. Crystalline form is but one property of a substance—more important to the mineralogist, doubtless, than any other physical condition, yet governed ultimately by chemical determinations. *The nature of the substance* is the one fundamental fact in the description of any mineral species.

It is not always easy, however, to prove definiteness of composition. A mineral may, to all outward appearance, be uniform in texture, and yet, seen in thin section under the microscope, it may be found to contain several different things. The microscope, therefore, with its adjunct the polariscope, is an important weapon in the hands of the mineralogist. By its aid he determines the mechanical purity of a given specimen; and upon examination under polarized light he can tell something as to its crystalline system, even though distinct crystals as such may not be visible. Few minerals are wholly free from mechanical admixtures, which complicate analysis, and vitiate the con-

clusions drawn from analytical results. Proof of homogeneity is an essential datum in the establishment of a mineral species. Many a supposed species has been overthrown by the microscope.

But a mineral may be apparently homogeneous, and yet indefinite chemically; for, apart from mere impurities which are unrecognizable by physical means, there are modes of admixture even more difficult to determine. Two distinct compounds may crystallize together in varying proportions, so as to yield definite forms which are, to all physical tests, perfectly homogeneous. Such mixtures of "isomorphous" substances are almost infinite in number; they are among the commonest occurrences in Nature; and they complicate the mineralogic problem enormously. Theoretically, a species is easily defined; practically, the definition is most troublesome. Oftentimes all the members of an isomorphous group are regarded as one species, in which certain analogous elements are said to "replace" each other. Iron and alumina are thus mutually replaceable; so are the oxides of the magnesia group; so also are sodium and potassium. But this usage, though common and sanctioned by weighty authorities, is not rigidly scientific. It is allowable conventionally, but only so long as we do not lose sight of what it really means. The so-called replacement is in reality a phenomenon of mixture between isomorphous salts of allied metals or acids, which salts are the true, definite species. For example, garnet varies in composition in just this peculiar way, and six or more compounds, all different but similar, are represented in it. Sometimes we find one of these compounds nearly pure; but oftener two or more exist in a given crystal. Garnet, therefore, is not one species, but a group, and should be so treated. A mixture is a mixture, whether visibly so or not, and has no title to specific naming. On a systematic basis the current policy needs modification; for it varies too widely and can not be universally applied. Seeking to evade one set of difficulties, it creates new ones.

In consequence of the tendency toward mixture among species, and of the wide-spread fashion of regarding the crystal as the mineralogical unit, there has grown up a general belief that minerals are in most cases very complex chemically. Some species, undoubtedly, are quite simple, like quartz, fluor-spar, or calcite; but others, especially among the silicates, appear to be most complicated, and even variable, in composition. This complexity, which is in great part due to the influences already mentioned, is perhaps apparent rather than real. Mixtures, whether crystalline or mechanical, can hardly be given either simple or definite chemical formulæ. The true individual units are probably not very complex, for their modes of origin favor simplicity. A complex molecule is likely to be unstable—the more complex, the more unstable; while minerals seem to be generated under conditions adverse to instability. Some have been deposited from solutions in which many reactions were possible; others originate under conditions

of high temperature; and in either case only the more stable compounds are likely to be formed. Simplicity of chemical structure is therefore to be presumed; and the reverse should be the exception rather than the rule. Great complexity may sometimes exist; but in most cases it may be traced to the commingling of isomorphous bodies, or to impurities which have been overlooked.

Suppose, now, that for a given mineral the true chemical composition has been made out and expressed in a definite formula. All errors due to interminglings of other bodies may have been eliminated, and yet something still remains to be done before we can truly understand the nature of the substance. Here we must draw from the stock of conceptions furnished to science by organic chemistry. Two or more compounds, identical in percentage composition, may be widely different in other respects. Among organic compounds this fact is one of the commonplaces, but among minerals it is rarer and less easily explained. For example, calcite and aragonite, differing in crystalline form and in physical properties, are alike in composition, both being simply carbonate of lime. The differences lie within the molecule, and arise from the fact that the atoms are differently grouped or arranged. Partly from physical evidence, and partly from ultimate composition, the organic chemist infers the number of atoms in an organic molecule, and by a study of the changes which a substance can undergo he draws conclusions as to the position of these atoms with reference to each other. These conclusions are expressed in terms of chemical structure. By reasoning, too special for review here, he accounts for the differences between two "isomeric" compounds, and by means of "structural formulæ" he symbolizes the relations of each to the other. Can similar reasoning be applied to mineral species?

It is easy enough to devise structural formulæ, even with all the limitations which chemical science imposes. Given a certain number of atoms, built up into a molecule, and we can represent them as arranged in a variety of ways. But, to have value, that way must be chosen which shall represent the relations of the substance under consideration to other substances, and which shall, therefore, fulfill a definite scientific purpose in the interpretation of known facts. Formulæ so devised are of great utility; they shed much light upon the changes which bodies undergo, and upon their possible modes of generation; and this they do independently of all speculative considerations as to their ultimate meaning. The simpler chemical formulæ express composition only; the structural formulæ indicate function also. The latter, equally with the former, is essential to the discussion of our fundamental problem, namely, to determine *the nature of the substances* with which we deal.

At the present moment mineralogy is just entering upon this higher field of chemical study. Some mineralogists are vaguely distrustful of the new structural conceptions; some are indifferent to them;

others are openly opposed. The latter, however, mostly belong to a school of thought which, chemically speaking, is obsolescent; and by refusing to accept the later notation they bar the doors of progress against themselves. They discover details, but they develop no principles. A reasonable distrust of novelty, however, is always legitimate; and the question may fairly be raised whether the methods of reasoning which are valid in organic chemistry can safely be applied to mineralogic research. The organic chemist deals with compounds for which the starting-points are simple and well known; in many cases he can determine molecular weights with ease; and his material is so plastic that it can be altered, built up, or transferred in readily traceable ways. Every step in his processes can be followed, and his results may be checked from many sides. Minerals, on the other hand, are hard and stubborn; they form slowly and change with difficulty; they can not be handled as systematically as their organic analogues, and the evidence concerning their chemical structure is therefore less complete and convincing. Still, the case is not quite hopeless, and much positive work may be done.

Just at this point the main lines of mineralogic investigation seem to converge toward the central stem of growth. Leaving out of account mere questions of descriptive detail, the raw material of scientific thought, we may consider three great divisions of study which touch the problem of chemical structure. First of all, we have the branch of associative mineralogy. Minerals do not occur together at random, in all conceivable groupings, but only in accordance with definite laws which are now subjects for investigation. We can not clearly formulate these laws as yet, but we are learning much about them empirically; so that in many cases, upon finding one species, we instinctively look for certain others, which we are quite sure must exist with or near it. Some minerals are found in granite veins, some in volcanic rocks, and some only in ore-bodies, and each one may be evidence for its neighbors. The chief work of the lithologist is in a limited portion of this field; for he considers the minerals which are aggregated into rock-masses, which latter represent definite and frequently recurring associations exhibited upon a large scale. The very classification of the rocks is based upon their mineralogical characteristics. Lithology, however, takes into account only a small minority of known species.

Now each well-established group of mineral associates indicates something relative to their origin. It represents the collective conditions under which they came into existence, and points distinctly toward the chemical reactions which formed them. If we study any one locality closely, we shall discover some details of curious significance. Some minerals occur enveloped by, inclosed in, or implanted upon others; some line cavities, and some represent incompleted processes. We see clearly that one was formed before or after another;

we trace out the left-over material which was last deposited; we find secondary growths built up from more primitive substances. Throughout we gather evidence bearing upon the life-history of each mineral, and this may be directly correlated with the conception of chemical structure. When we can determine the conditions under which a compound can be formed, we shall have made a long step forward in understanding the nature of the substance.

The second of our three lines of investigation is closely allied to the first, and, indeed, overlaps it somewhat. It is the study of alterations. A mineral has not only an origin and growth, but also a process of decay, during which its material, disintegrated, is made over into new forms. It is very common to find a crystal with its nucleus unchanged, and its surface transformed into some other species. Some of these alterations are easy to understand; as when, by oxidation, a cube of iron pyrites becomes a cube of the brown hydroxide, limonite; or when an arseniate or sulphate is derived from an arsenide or sulphide. Other changes, however, are less simple, such as the transformation of topaz into mica, or of corundum into margarite; but all of them tell something as to the nature of the substance altered, and help to elucidate the problems of structure and function. An alteration product is the record of a chemical reaction, which may be traced and reasoned about; and the evidence which it offers is quite analogous to that used by the organic chemist to determine the structure of a carbon compound. In the latter case alteration products—that is, derivatives—are produced artificially; in the former the mineralogist finds them ready formed in Nature. Unfortunately, however, such alteration products are not attractive specimens; and the ordinary collector throws them aside as worthless. An altered crystal has lost its perfection and beauty, and is valuable only for what it signifies. But, from a scientific point of view, its value is real and considerable, if only it be studied thoroughly, apart from superficial appearances, and without jumping at conclusions. Here, again, the microscope and the chemical analysis are necessary coadjutors.

One line of research yet remains to be considered. The two already disposed of deal with material as gathered in the field; the third is an affair of the laboratory. Of late years many mineralogists have been actively at work upon the synthesis of minerals, building up their crystals by artificial means, and reproducing in a rapid way the slower processes of Nature. Many species have thus been formed in well-defined condition; and other compounds, different from but closely analogous to well-known minerals, have also been produced. Every year there are great advances in this field of work, and every step which is taken is in the direction of the main problem. Sometimes results are attained by methods unlike those which grew the native crystal; but even then new light is shed upon its nature, and we know more of its possible modes of genesis. Some experiments

also bear upon the subject of alterations; and definite alteration products are artificially obtained. So far, little has been done toward generalizing upon this class of observations; but, as the facts accumulate, new relations will appear and reasoning must follow. Each experiment suggests new experiments; each discovery points toward others, and the connecting theories will grow up around the conception of chemical structure. It is the only conception yet clearly recognized which is general enough to cover the whole field.

It has already been argued that the physical study of minerals is subordinate to their chemical investigation, for the reason that all properties depend upon composition. Physical researches, nevertheless, have great value in mineralogy, and a paper under the caption of this essay would be wretchedly incomplete if it failed to consider them. Physical data, moreover, aid in the discussion of chemical structure, and point out analogies of weighty significance. Specific gravity, for instance, is always an important datum in the study of a species; and the ratio between it and the molecular weight of a compound tells us something of the condensation which the elementary material has undergone in combining. One eminent mineralogist is now using this ratio as a basis for mineral classification, especially among the silicates; and his results are likely to emphasize the conclusions drawn from quite different sources. This method of study, however, presupposes a knowledge of true chemical composition. With the latter it means much; alone it signifies little.

Upon the thermal and electrical properties of minerals comparatively little has been done; and that little has slight reference to mineralogy in general. The optical constants, on the other hand, are elaborately studied by mineralogists, on account of their direct relations to crystalline form. Indeed, optical and crystallographic work is a dominant feature of modern mineralogical investigation, although a great part of it never rises above the plane of mere descriptive detail. In its higher aspect it deals with the internal molecular structure of crystals, and so furnishes data which may some day be connected with the broader general conceptions of the chemical field of research. The question of how the atoms are grouped has a mechanical as well as a chemical side; and some time it will be systematically attacked from both directions. At present we only see the future possibility of so handling the physical evidence; but the expectation is philosophically just. To-day a knowledge of crystalline form is mainly useful in the identification of minerals; for by it we may determine a species without destroying the specimen; but its deeper potential significance is none the less apparent. Along these lines we may safely prophesy progress, which can only end in the complete correlation of all mineralogic facts, and therefore in the solution of the fundamental problem.

Looked at from the descriptive side alone, mineralogy is a small

affair. Only about a thousand species are known, and one large volume may fairly cover the field. It is when we consider the mineral as a growth—as a body having a past and a future—that broad treatment of the subject becomes possible. The geologist, dealing with phenomena of the grandest character, sees at a first glance little that is attractive in mineralogy. He forgets that mineral species make his alphabet, and that upon their properties the properties of rock-masses must depend. He can not safely generalize upon the one without knowing something of the other. He can not understand the chemical changes occurring in the earth's crust, if he ignores the separate units and the reactions of which they are capable. The very genesis of many rocks must depend upon the conditions under which their individual units can concurrently exist, and the latter must be known before the larger question can be adequately handled. Mineralogy gives to the geologist the weightiest of evidence. To the chemist also it is something more than debtor. It gives him, ready made, whole groups of compounds which else would be difficultly attainable, and these are the starting-points for many lines of research. The true character of each science is best seen in the interaction of all the sciences. Each in its way is both servant and master; not one can stand wholly alone.

THE UNIFORMITY OF SOCIAL PHENOMENA.

By F. X. von NEUMANN-SPALLART.

THE surprising consequences which have attended investigations in natural science have excited among the representatives of historical and speculative studies a desire to reach results of corresponding value by the application of observation and analysis to the affairs of life. In this manner has arisen a new school of historical research, which applies the facts of physical geography, anthropology, ethnography, and other related branches of science, to the explanation of events, and by this means has passed from mechanical transcription and compilation to the examination into the natural, causal connection of things. In the same way, speculative philosophy has happily become an inductive branch of investigation, and instead of the "eloquent words" with which metaphysics used to labor, scientific analysis satisfies the aspirations in that direction, and is reviving with its refreshing breath the withered branches of the world's wisdom. It is not out of course, then, that the sciences of social life also should try to discard the tinsel of empty words and to gain by scientific methods a concrete understanding and a real view of their conditions. The question has thus arisen, whether the endlessly complicated and shifting events which are incessantly modifying the aspects of human society can be followed up and explained by natural laws;

whether there is, in fact, a social physiology. Investigation in the ordinary sciences was facilitated by the discovery, which was early made, that its objects grouped themselves in classes, of which each individual corresponded with a common type, and that what was observed of one could be predicated of all of its class. Were social phenomena susceptible of a similar generalization?

The question has only recently been answered with clear knowledge; but hints of the solution were given two or three hundred years ago to one or two favored thinkers. Giambattista Vico made the first approach to it toward the close of the seventeenth century, in his "Scienza nuova." Johann Peter Süssmilch gained another glimpse of it a hundred years afterward. Half a century after him, Herder advanced the doctrine that a plan ruled in social development, the discovery of which must be sought through the study of the philosophy of history. The application of mathematical calculations to human events is due to two astronomers. Laplace, investigating the law of probabilities, suggested that the methods of observation and calculation might be of service in social and intellectual studies. The second astronomer, Quetelet, was the real founder of social physiology. Since his investigations there has been no doubt of the practicability of studying, by the methods of natural research, those social phenomena which had previously been only looked at through the telescope of speculation; for he, not contented with mere suggestions, made actual analyses of civil society; instituted mathematical investigations with groups of vital phenomena, to which only a few before him had ventured to apply the measuring-rod; showed the regularity of the formation of the social body and of its vital manifestations; and made apparent the close relations of cause and effect in the apparently voluntary acts of men in society. The followers on Quetelet's lines during the last thirty years have been very numerous. A whole school have adopted exactly his spirit and methods; others have worked analytically; and others have endeavored to build up a metaphysical sociology. The literature of many nations, particularly of England, Germany, France, and Italy, has now a legion of works aiming to investigate the phenomena of social life from the most diversified points of view, tenable and untenable; they differ widely in character, but all agree that the laws of human social phenomena are a legitimate subject of study. The mathematical method has been vastly aided during the same period by the operations of the statistical bureaus that have been established in most civilized countries, in collecting and classifying facts, which, with the averages they afford, are to the social philosopher what his chemicals, microscopes and instruments of precision, and his experiments, are to the natural philosopher.

The great progress which has been made in the comprehension of the principles of social philosophy is due to the method which has been adopted of laying aside for a time the consideration of single

things and individuals in society and viewing it as a whole. The aggregate of those hundred thousands or millions of men which we call a people, a nation, or a society, forms, when regarded as if from without, a higher unit, in which the willing, transitory individual disappears and no longer exerts a disturbing influence on the observation of the great average. The society as an organization, not the individuals in themselves, is thus the object of social physiology. We can give such descriptions of society as a whole, of its structure, form, connections, and other peculiarities, as the mineralogist or the chemist, the botanist or zoölogist gives of matter and plants and animals; which are just and useful for a time, and form the descriptive or anaomical part. We can, too, further observe the organic functions of society as such, and deduce laws of cause and effect which are also available for a time as physiological laws—for a time, but not for always; for, quite in accord with more recent natural research, which endures no pause, but is always in movement and in a state of evolution, is a constant process of change exhibited in the circumstances of human society, without our meeting, on account of it, any contradiction with the principles from which we may have started.

We may describe social phenomena as vital and physical, and as ethical and psychical.

In order to obtain a proper position for deducing the general laws of social phenomena, it is necessary to overlook for the moment all concrete personality or individuality, and to regard, say, all the forty-five million inhabitants of the German Empire, or all the Germans in Europe, only as parts of a great whole, of a grand aggregate, describable under the name of a social body. We must imagine these men as in so close a reciprocal connection that, like the cells of a plant or animal, we can not conceive them as dismembered, but must regard them as forming by their union a single organism, a society, or a state. As in plants and animals each group of cells has its particular functional distinction, so here we meet groups of men among the millions constituting the whole, performing different parts in the common structure. One group will be engaged in material labors, another in the intellectual labors of religion and instruction; others in pursuits of art, science, jurisprudence, law, or the æsthetic development of the organism, and so on in an infinite diversity of adaptations, as among the parts of single living beings. Such a vision could be obtained in perfection if, as Huxley has imagined, one were an inhabitant of another planet, come to take a view of the whole earth and its inhabitants from some convenient distance where he could include the whole at a single glance. As we approach the realization of such a view, we gain a marvelous comprehension of the regularity of the types of masses of men, and of their normal composition and common properties. Take the sexual division of mankind. Although over the whole earth a general equality in the numbers of the two sexes

prevails, nevertheless each land has its peculiar, apparently constant characteristic sexual composition. In Europe there anciently and still is a greater excess of women in the north than in the states of middle Europe and the east, in some of which the women are in the minority. Through Europe as a whole the number of women is very definitely in excess of that of the men, and the excess appears to be increasing. It was very great after the Napoleonic wars; then the numbers gradually tended toward equality and nearly reached it (1847 to 1850, 1,009 to 1,000); then they diverged again, and stood, in 1870, 1,037 to 1,000. The phases of increased difference are generally observable after wars, and latterly appear to be the result partly of the enormous emigration which has taken place to other quarters of the earth. In America as a whole, and in Australia and Africa, on the other hand, whither this emigration with its preponderance of males is tending, the men are in excess, and the excess is increasing with the constant arrival of new parties of immigrants. Nevertheless, a near approach to equality prevails over the earth as a whole, and this whether we regard the white, black, or red races, or their mixtures.

Another instance of typical regularity of structure is seen in the constitution of society by ages. Each country has its characteristic peculiarities in this respect. In France, for example, the percentage of children is the smallest, and that of men of from forty to sixty years, and of old men, is the greatest; while in the United States the exact contrary rules. European states generally lie between the two extremes, and present constant normal figures. The age-constitution of each country might be represented by a pyramid, the base of which should be made up of the class of the youngest, and the summit of that of the highest age. Such pyramids would have their particular proportions for each country, which would suffer only gradual changes through the continual operation of social and political influences. The pyramids standing for the United States and Hungary would have very broad bases, and rise by much sharper angles to their tops than those for France, Belgium, and the Netherlands, where children are relatively less, and middle-aged and old men more numerous.

A similar constancy is observed in respect to civil condition. Except in France—where the proportion of the married is greater and that of the single is less—of the whole population of all ages in the several European states, and with but little variation in any single state, sixty-two per cent of the male and fifty-nine per cent of the female inhabitants are single, thirty-four and thirty-three per cent are married, and six and eight per cent are widowed. Taking only that part of the population between forty-one and fifty years of age, with similar constancy, seventy to eighty-four per cent of them are married. Similar constants have been established with reference to religious confession, nationality, the choice of occupations, and

other features and habits of different nations, but we pass to the consideration of a few special qualities. We are accustomed to distinguish our friends and acquaintances by their individual peculiarities, and we think we find very marked differences between them. Every man has his peculiarities of stature, girth, weight, color of hair, skin, and eyes, proportion between his limbs, strength, and pulse, but they all disappear, as Quetelet and others have shown, in the aggregate. The margin of variations in the individual traits of men is shown, by the measurements which these authors have applied to large groups, to be really very small. Among large masses of the population of a land as a whole, we find the same relative proportions of large, small, and middle-sized men, and constant relations in the number of thin, delicate, and bandy-legged persons, Falstaffs, strong and weak, quick-tempered and cool-blooded. The same is the case with the color of the hair, eyes, and skin, as Virchow has shown in Germany and Bertillon in the schools of France. Such a constancy in these traits has been shown on all the points hitherto inquired into, that we are able to draw similar conclusions on questions of race and nationality from these anthropological researches to those which the geologist deduces from the strata concerning the age of the formation.

Even those afflictions which we regard and lament as purely casual visitations on some families, such as blindness and deaf-mutism, exhibit a remarkable constancy of prevalence in whole societies. It may be a sufficient illustration of this to mention the striking fact that several computations of the number of persons suffering from these defects in Austria-Hungary and the German Empire, made independently of each other, at different times, and in different ways, have given the same numerical results; and that the numbers in other states are curiously near to those in the two mentioned, often differing only by a decimal. Although there are groups of states in which somewhat different ratios prevail, the frequent recurrence of the same average per ten thousand inhabitants, in a whole series of states, and for different decades in time, justifies the assumption that some law of proportion prevails, and forbids our supposing that the number is merely an affair of accident. On the basis of a number of coincidences of this kind, Quetelet constructed his ideal of the "average man," as a general standard by which to estimate the conforming proportion of the aggregate, and compare the individual with the type.

From the natural peculiarities, from the compositional structure of social bodies, we go a step further to their vital activities, their real physiology. Henceforth we may consider the curious variances in human generations, formerly regarded as accidental and voluntary combinations, as subject to a strict law. Within the circle of our acquaintance are childless families, and families that are blessed with hosts of children; families with all boys, and families with all girls; some strangely assorted marriages; men of extraordinary age, while we

may remember other men who have died in the flower of their youth. All these things seem to us accidental and unaccountable; but social physiology shows that they, as well as other human movements, are governed by fixed and irrevocable laws.

We might expect some regularity in the rates of births and deaths, for these are necessarily conformable to the laws of Nature; but there is something to cause surprise in the fixedness of the rates, and the regular grouping of the various conceivable cases. It is also a curious fact that not only do a certain number of children come to each population year after year, but that the nativity figure also forms a characteristic trait of individual nations, and that in any particular course of years, when the regularity is not disturbed by any external cause, like a war or an epidemic, it hardly varies by a decimal part. This regularity extends even to the proportion of those who are born of either sex, the general average of which is expressed by the numbers—100 girls to 105·38, or, including still-born, 106·31 boys; and if this proportion is disturbed in any one year, it is almost certain to be made up in the following year.

International statistics show also a remarkable steadiness in the proportions characteristic of different countries of legitimate and illegitimate births, of quick and still-born, of twins, triplets, etc., which the complications often prevailing in the combinations only bring more clearly to light.

The same regularity is manifested in the death-rates, in which, whether we take long or short periods of time, the deviations from the fixed average are very slight; and all the acquisitions of modern civilization, with the great improvements that have been made in medical science and its applications, have not yet effected a material prolongation of the average of human life.

If any fundamental social fact is voluntary it is marriage; yet the ratio of marriages to the population is in most countries even more constant than that of deaths. The same regularity prevails in the peculiar features of the marriages; the same proportions of the marrying pairs are constituted of both single persons, widows and bachelors, widowers and spinsters, or both widowed. A curious uniformity prevails in the matter of disparity of ages, and other exceptional features, and finally of separations and divorced persons, of second, third, and more numerously repeated marriages. Each country has its own times of year or months when the most marriages take place. They are February and November in France, Austria, and Italy; May in Holland and Belgium; November and December in Sweden and Norway; and the fewest marriages take place in March, July, and August in France, Italy, Belgium, and the Netherlands; in August and December in Austria.

The intellectual qualities of a people do not lend themselves to measurement so readily as do the concrete peculiarities we have no-

ticed. There are, however, a few criteria within our reach by means of which we are enabled to judge with some approach to exactness of the extent of the range within which the average standards of these qualities vary. The criteria are afforded by intellectual defects and aberrations, such as insanity, idiocy, the mental disorders arising from certain physical diseases, criminality, and the propensity to suicide. The information given by the statistics of the circulation of newspapers, letters, and telegrams; the results of the examinations of schools and for the military service; and even the statistics of misdirected letters, are all made of service in this investigation. They exhibit a tendency to uniformity which, although it does not always appear as marked as in respect to some of the qualities that have been considered, is nevertheless real. It is particularly striking in the case of suicides, concerning which Morselli has published very complete and minute statistics.

There need be no real difficulty in showing that the freedom of will and action which we accord to human beings and societies is consistent with subjection to the laws of social physiology. While we have not sufficient physical vigor to live more than a certain number of decades; while we are restricted in our scientific and artistic efforts by the capacity of our brain and nervous system; while we are preponderantly subject to the influence of the intellectual, political, and social currents of the age; while we are dependent on our geographical situation, on climate, soil, and the price of food—it is not yet necessary that we should be deprived of the attribute of free will. The laws of social physiology, although they have been deduced by observation as laws of Nature, and have suffered modification only through a short evolutionary epoch as compared with that through which the laws of Nature have subsisted, give nevertheless sufficient room for individual development. Because in the whole social body only the final results appear of the endless diversities existing within it, the freedom of individuals is consistent with the regularity of the whole. This whole, moreover, is itself not a stationary or rigid body, but an organism that is giving itself specific cultivation, and is continually suffering change, metamorphosis, and further development. An entire civic society can, by its collective will, modify, within the limits imposed by natural laws, all those properties and laws which we have discovered in the domain of social physiology.—*Translated and condensed from the Deutsche Rundschau.*

Dr. Alfred Russel Wallace acknowledges that the Americans possess, in respect to educational institutions, some special advantages over his own countrymen. They are comparatively free from Old-World establishments and customs; are not afraid of experiments; and seek, in whatever they undertake, to have "the biggest thing attainable." These features are manifested in some of the great American museums, "which rival, in certain special departments, the long-established national museums."

THE CHEMISTRY OF UNDERGROUND WATERS.

By Professor G. A. DAUBRÉE,
MEMBER OF THE FRENCH ACADEMY OF SCIENCES.

TO understand the chemical composition of subterranean waters, we must inquire anew of the geological constitution of the country, and it will usually answer with precision and certainty.

Water does not have to remain long in the soil to dissolve and remove various substances from the rocks. Chemical analysis has already shown that such substances exist in the water-sheets of alluviums in more notable proportions than in the neighboring rivers. The difference is sufficient to explain why in Hungary, Egypt, India, and China, river-water is preferred to well-water for culinary uses. In the subsoil of inhabited places, water is not charged with mineral substances only; but the liquids of manure-heaps and other elements of corruption are transmitted to it by sewers, factories, and cemeteries. The unhealthy effect of the impurities thus conveyed to the wells has been frequently recognized; and it would be surprising if water exposed for centuries to such infiltrations did not cease to be potable.

The most common bodies found to be contained in subterranean waters are oxygen, nitrogen, and carbonic-acid gases, chlorides, carbonates, silicates, and sulphates of lime, magnesia, and soda, and organic substances, in the presence of excessive proportions of which water may cease to be drinkable, or even fit for domestic uses.

Water sometimes acquires also useful properties during its subterranean course. Springs which are employed as therapeutic agents are endowed with mineral qualities. The name of mineral is sometimes extended to other springs the high temperature of which makes them susceptible of similar uses, even when the amount of foreign matter they contain is inferior to what is included in many potable waters.

Chloride of sodium, or sea-salt, is sometimes present in so feeble proportions as not to be perceptible to the taste. It is derived from very widely distributed rocks, which contain traces of it. In other springs it exists in much stronger proportions. Such springs derive their salinity from beds of rock-salt, which it has been found profitable to mine or bore for directly.

Gypsum is dissolved in water under similar conditions. It is present in large masses and in a very fine state of division in the Parisian Tertiary beds, and, being freely soluble, gives hardness to many springs. It is often associated with other substances, which give therapeutic qualities to water, as in the cold springs of Contrexeville and Vittel in the Vosges, and the hot springs at Agovie and Schinznach in Baden. The mineralization in these cases is due to the presence of the soluble sulphates of lime and magnesia, which are furnished by

the gypsiferous beds and dolomites of the Trias. At Birmenstorf the natural leaching of the gypsum rocks is imitated artificially; and either salt is dissolved according as it predominates in the particular stratum on which the process is performed; so that two kinds of medicinal waters are prepared. The purgative springs of Sedlitz, Seidschütz, and Püllna in Bohemia, derive their sulphate of magnesia from the Tertiary marl which they have traversed; and, this fact once recognized, similar waters have been produced for half a century by washing the rock—an experiment which was the starting-point of the artificial mineral-water industry. The origin of most of the sulphureted waters, or, to speak more exactly, of their sulphuret of calcium, is explained by the facility with which the sulphates can yield their oxygen to organic matters; a thing which occurs notably when carbonaceous matters, lignite, stone coal, or bitumen, are found associated with gypsum.

The origin of gaseous or acid springs, which constitute one of the most important families in a hygienic aspect, is connected with exhalations of carbonic acid, which are in turn one of the most remarkable phenomena of the globe's interior economy. The emanations of carbonic acid, as well as the springs to which they give character, are most commonly grouped near volcanoes, active or extinct, and ancient volcanic rocks, basalts, and trachytes. The granitic table-land of central France, in the chain of the Puys, as in the masses of Mont-Dore, the Cantal, and the Vivarais, exhales daily torrents of the gas, either dry or in solution, from more than five hundred springs. There are Royat, with its tumultuous ebullition, Saint-Allyre at Clermont, Saint-Nectaire, where all the oozings of the ground, even the road-ditches, boil with gas. Disengagements of carbonic acid are frequent in the mines of Pontgibaud, which are situated on the side of a crater and an ancient lava-flow, and where veins of silver-bearing lead-ore furnish conduits for the asphyxiating gas.

Countries where the volcanic rocks do not appear on the surface, but which are broken by deep dislocations, may also be the seat of exhalations of carbonic acid. The gaseous springs of Pongues, and some others of the Niévre, are situated upon simple faults. In northern Germany, on the left bank of the Weser, the country is riddled with fractures which give passage to abundant disengagements of carbonic acid, especially upon the plateau of Paderborn, and in the neighborhood of Pyrmont, Disburg, and Meinsberg. Acid springs occur under nearly the same conditions of stratification as the warm springs of which we are about to treat; and, like them, they reach the surface with the assistance of quartz or other mineral veins.

Sometimes the carbonic acid is abundant enough to make the waters in which it is incorporated spurt up violently; as at Montrond, Loire, where the intermittent eruptions from a depth of five hundred metres attain a great height; and at Nauheim, in Vétéravie, where a

column of salt water has been spouting for forty years. As a counterpart to these phenomena of solution, waters form deposits which are interesting for more than one reason. Reaching the open, thermal and gaseous springs meet conditions of pressure and temperature different from those which ruled in the depths, and are consequently subjected to reactions to which the oxygen of the atmosphere frequently contributes. The deposits which they make are observed chiefly on the surface of the ground.

Lime, which is very abundant in the condition of a carbonate, is always in solution, in small quantities at least, and in larger quantities when free carbonic acid is present to assist the process. The conditions which provoke the disengagement of the gas at the same time determine the precipitation of the calcareous salt; and this is why calcic carbonated waters often give rise to important deposits. The ancients were impressed by the stalactites of caverns, and by petrifying springs which covered plants and other bodies immersed in their basins with a stony precipitate. Industry has profited by the property, and has obtained in petrifactions bas-reliefs and images of a very delicate molding. In many places the deposit has become extensive enough to constitute a rock formation like the travertine at Tivoli, which furnished building-stones for Rome.

Silica, although regarded as insoluble in water, may become associated with it by the aid of intermediate agencies, and form combinations which are even the predominant elements of some springs, as at Plombières, Bagnères-de-Luchon, Ax, Saint-Sauveur, and Amélie-les-Bains. Sometimes silica is so abundant that it is isolated as opal on coming in contact with the air. The basins of many geysers are thus carpeted with it.

Iron-ore, or limonite, is also constantly in formation in such quantities that the beds can be worked. It is known, according to the conditions under which it is deposited, under the names of bog-ore, field-ore, or lake-ore. It is generally buried at slight depths below the surface, forming thin beds. Its modern origin is demonstrated by the presence of products of human industry, such as fragments of pottery and utensils, which are met in the massive blocks; and it is, moreover, sometimes renewed in places where it has recently been worked. More than a thousand lakes in Sweden, Norway, and Finland supply this mineral in rounded and separated globules. Although its formation is in constant continuation, the cause of it has been for a long time misapprehended. It is a result of slow dissolutions which have been frequently observed in arenaceous clays. Rain-waters traversing them, having seeped along roots undergoing decomposition, take from them an acid principle, and thus acquire the power of dissolving oxide of iron as they go. Reappearing in the air, they abandon the hydrated peroxide of iron, leaving it as a brown, gelatinous precipitate. Organic substances in this way contribute to the formation of mineral matters.

According to recent investigations, the almost boiling Steamboat Springs in the United States precipitate, besides sulphur, small quantities of gold, mercury, silver, lead, copper, and zinc, which, by the aid of certain salts and their high temperature, they hold in solution. These deposits appear to be the continuation of those which in the same region, as at Sulphur-bank, have formed beds which are mined for their mercury.

What we have been able to observe from the surface of the ground gives a very limited and imperfect idea of the actions which excavations made to secure some particular thermal waters have revealed to us. The bottom of the basin of the principal spring at Bourbonne-les-Bains, where the temperature reaches 68° C., has furnished some very remarkable facts relative to the formation of minerals. The place was a flourishing station in the Roman period. In draining an ancient well a blackish mud was reached which contained fragments of wood, acorns, thousands of filberts which had become black like lignite, and numerous medals. The washing of four cubic metres of the mud yielded more than five thousand pieces of money, mostly of bronze or tin, but some of silver and gold. The four coins of the last metal bore the images of Nero, Hadrian, Faustina the younger, and Honorius. Twenty of the silver pieces belonged to the Gallico-Roman period, while the other coins were consular or imperial pieces, mostly of the first centuries of the empire; but some were as recent as the Lower Empire. The bronze pieces of the medium and smaller sorts were likewise of different ages, but three types of Augustan coins predominated. Many of them had been cut in two, doubtless to prevent their being taken out and used again, they having been cast in as offerings to the health-giving fountains. *Ex-voto* offerings were also recovered, including a bronze statuette of a man whose leg had been hurt.

Some of the coins had been so corroded by the action of the hot water that the figure on them could not be discerned. Others had been further corroded into holes and notches. Many others had been wholly dissolved, but had engendered, at the expense of their bronze, new and solidly agglutinated combinations. The species thus originated were identical in their crystalline forms and general characters with similar natural minerals—sulphuret of copper, copper pyrites, and variegated copper-ore. The most numerous crystals are regular tetrahedrons, like those of the mineral called gray antimonial copper, of which they have also the composition, the luster, and other properties. In some of the coins the tin of the bronze has passed into the state of an oxide, and has formed a white superficial crust. A real separation has therefore been produced between the metals of the alloy by the different workings of their chemical affinities. It seems as if in all of these transformations Nature, claiming her rights upon what human industry had taken out of her domain, had been pleased, with the aid of the mineral water, to recover her property, and reconstitute exactly the

ores of copper and tin which the miner's operations had taken from her, and from which the furnaces of the metallurgists had laboriously extracted the two metals of bronze.

Lead pipes, of which there were a great number in connection with a white marble piscina, had suffered a no less energetic alteration. They were deeply corroded and perforated, and had by solution formed minerals with bases of lead—the sulphuret, or galena, and the chlorocarbonate, or phosgenite.

Among the iron compounds the bisulphuret, or pyrites, is of special interest, on account of its abundance in the crust of the earth. At Bourbonne, and in the basins of other thermal springs at Aix-la-Chapelle, Bourbon-Lancy, Bourbon-l'Archambault, and Saint-Nectaire, pyrites has been detected in course of formation, but only in the deeper parts of the basin remote from atmospheric oxygen.

In view of these changes, wrought by thermal water on inorganic bodies, it is not surprising that the same agent should also act upon organic bodies. The wood of the piles supporting a masonry-work, while it has perfectly preserved its texture, has become hard and heavy with the mineral matter which it has absorbed. The original substance has almost disappeared, and given place to carbonate of lime, which has penetrated, as the miscroscope shows, to the most minute interstices of the vegetable cells.

These springs of Bourbonne have given rise, within a very limited space, to not less than twenty-four species of crystalline minerals, in combinations which, accumulated and grouped as they are, closely resemble the ancient metalliferous beds—in detail as well as in general.

Other evidences of the mineralizing power of thermal waters have been exhibited in their operation for considerable distances below the surface of the ground. Penetrating the subsoil at Plombières, they have since the Roman period engendered a series of species no less remarkable than the preceding series, although they did not attract attention by a metallic luster; they are silicates of the zeolite group, opal, and chalcedony. When we try to apply the experimental method to the reproduction of geological phenomena, we are met, among other difficulties, by the brevity of human life, which is very short in comparison with the immense periods which have presided over the formation of the crust of the earth. Such facts as these, fortunately, make up for this inability, and put us in the presence of experiments that are forbidden to our laboratories, from which we learn what can be effected by very weak actions prolonged through ages. By these synthetic demonstrations, carried on during twenty times the duration of human life, Nature teaches us that she is still employing processes similar to those which she used in the most remote epochs.

We come now to see how subterranean waters obtain a heat which makes them thermal springs, and which connects them by intermediate

agents with volcanic phenomena that are still, at first sight, so different and almost contrasted. The temperature of springs is generally nearly equal to the mean temperature of the ground from which they issue. But there are some exceptions to this usual condition, which are called thermal; a term which should be applied, not only to waters manifestly hot or warm, but also to those which by thermometrical indications differ by only two or three degrees from the normal temperature. Thermal springs are not always, therefore, distinctly separated from ordinary springs.

The extreme variations of temperature which we feel so vividly, according to the seasons, penetrate the ground very slowly and gradually subside, till they become insensible at a depth which is measured at Paris as of about twenty-five metres. Below this stratum of invariable temperature, the heat gradually increases as we descend; a fact which is not confined to temperate regions, but has been observed in countries near the equator and near the poles. It has been demonstrated by observations made in mines, in tunnels, and in artesian wells.

It is evident that this internal heat can not emanate from the sun nor from any cause exterior to our globe, for, if it did, it would not increase as we descend. It appears to be the resultant and continuation of the heat through which our planet has formerly passed. In radiating toward the celestial spaces, which are colder than anything of which we know, the outer masses are necessarily consumed first, while the heat continues intense in the central masses. In consequence of this general increase of heat, there are present in all parts of the interior of the globe, even far away from active volcanoes, rocks, contact with which heats water in a greater or less degree.

We have now to examine the various ways in which the structure of the rocks permits water, after it has descended to great depths, to return to the surface. The simplest way is by a turning back of the strata. The water of the artesian wells of Paris has been forced, having entered at the outcrops of the beds, to descend, between impenetrable strata, to a depth of which it has taken the temperature. The existence of a vast thermal bed under a part of the north of France would not have been revealed without the borings which have opened a way of return to its waters. But if the strata to which we refer, instead of being disposed in a vast concave basin, are subjected to a bending which would bring them up again to the surface, their thermal water would return with them, as if drawn through a siphon. This is the kind of a disposition which Nature has made real in countries where the strata have been bent under strong mechanical action. Such a structure may be recognized in the cases of the springs of Barbotan, Baden, Schinznach, Aix-la-Chapelle, Bercette, and in the Appalachian Mountains in Virginia.

Another mechanism of Nature, yet more closely resembling a siphon, is furnished by the large, nearly vertical fractures called

faults, which descend to an indefinite depth, far below any point which it is possible for us to reach. Generally, they serve only for the direct descent of waters which, having been swallowed into them, find a little farther down an outlet from which they issue still cold. But it also happens, and the fact should be kept clearly in mind, that a fault offers a return route to water which has been heated at great depths. This is the case at Bourbonne-les-Bains. In the Alps, according to M. Lory, the same fault feeds the thermal springs of Monestier, Briançon, Brides, and Salines near Montiers. The fault which cuts and terminates the chain of the Alps near Vienna in Austria is the emissary of a considerable number of springs. Most of them are cold; but some hot springs, as those of Baden and Vöslau, are ranged along a distance of eleven kilometres.

The return branch of these natural siphons is often filled up and obstructed by incrustations which the water has formerly made, so as to form metalliferous veins. If the obstruction is not complete, or if it has been opened by mining excavations, these veins may be still serving for a way of ascent. A passage pierced at Plombières some thirty years ago in the granitic flank of the valley for the regulation of the warm waters, cut several veins of quartz and fluor-spar, along the sides of which springs gushed out forcibly. A similar incident took place at Lamalon, in Hérault, where it became necessary to stop the working of the veins of copper and lead, in order not to compromise the existence of the thermal establishment, the source of which was only a few dozen metres away. In the Comstock lode torrents of water having a temperature of 158° Fahr. gave out such heat that the workmen had to use ice to cool their shafts; and after twenty years of most profitable operation the mines became the object of great expenditures to obviate this difficulty.

It is for the most part in the neighborhood of extinct volcanoes and rocks of a volcanic nature that faults produce thermal spoutings. While such springs are usually wanting in the greater portion of the French central granitic plateau, they abound in those regions of the same plateau which are traversed by volcanic rocks.

There is no reason, therefore, to be surprised at finding the region of active volcanoes itself rich in emanations of this kind. Puzzuoli, Baiæ, and the baths of Nero, are situated near the solfataza of Puzzuoli and the ancient craters of Agnano and Lake Avernus. On the island of Ischia, as at Guadeloupe, the hot waters gush copiously from the flanks of the volcanoes.

We also observe near volcanoes boiling water violently projected into the air by torrents of vapor. The noise they make, which is like that of a steam-boiler, has caused the name of "Steamboat Springs" to be given to a group of this kind in the State of Nevada. Such springs are in close analogy with others in which the water is forced up, in the shape of a tall column, by intermittent eruptions. The latter have

received the generic name of geyser, from the Icelandic word signifying *to spout*. One of the most remarkable geyser regions in the world is in the western part of the United States, near the borders of Wyoming Territory, where are grouped together more than two thousand very hot springs, which we might imagine to have been engendered by some vast steam-furnace.

Waters may also acquire a high temperature by borrowing from eruptive rocks which have been thrown up from greater depths and still retain a part of their primitive heat. They generally rise by the force of hydrostatic pressure, as in the artesian wells, while the expansive force of vapor is sometimes the elevating agent. Volcanoes, the eruptions of which suggest only the idea of fire, constitute, in fact, gigantic intermittent springs of water, the temperature of which surpasses everything that we can comprehend.

Thus, the vapor of water not only forms the most abundant and most constant product of eruptions, but it seems even to be, through its enormous tension, the mother of them. From the very beginning of the crisis it bursts out in enormous spurts, dragging matter of every kind up the subterranean conduit. This vapor produces a vertical column which spreads out in the upper regions of the atmosphere in the shape which in Italy Pliny has compared to that of a pine-tree. It is sometimes blackened, especially at the beginning of an eruption, by solid dejections of cinders or lapilli. The watery column may reach a considerable height if it is not carried away or dissolved by aërial currents. Torrential rains frequently fall from the clouds engendered by these exhalations.

Impossible as it may appear, water is incorporated in fused and incandescent lavas, and consequently participates in a temperature exceeding 1,000°; but when it is vaporized its temperature falls at once to the boiling-point.

The water expelled from volcanoes gives only a very limited idea of the importance of the domain of that fluid in the depths of the earth. When we consider how many opportunities it finds to penetrate by capillarity and other means into interior regions of a very high temperature, we can not doubt that these regions contain superheated water. Imprisoned within rocky walls that offer an enormous resistance, it acquires a tension which recent experiments show to be of marvelous power.

Water also contributes invisibly to mechanical actions. In view of the immense force it exhibits in eruptions, we have a right to suppose that in regions where it has no outlet it may, under the force of its enormous pressure, be also an effective cause of the most formidable earthquakes, which are simply volcanic eruptions without outlet. These agitations are produced more especially in countries the ground of which is dislocated and has most recently acquired its present relief. Such a geological constitution, which is recognized as

especially connected with earthquakes, would have the precise effect of favoring the admission of water through its large fractures to deep and hot regions. Conditions of this kind are realized in all the parts of the basin of the Mediterranean which have been so frequently and violently agitated within historic times.

The facts that subterranean waters have thus taught us for the present epoch will aid in giving an idea of what they have effected in the extremely remote times of the geological periods. Minerals, which are their work, permit us to follow the track which they have left behind them through thousands of centuries.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

THE CAUSE OF CHARACTER.

IT may be taken for granted that almost everybody has a character, be the same more or less, good, bad, or indifferent, as the case may be. The exception, in fact, need only be made in favor of imbecile persons and idiots, who usually possess no character at all to speak of, or whose character is, at least, of a decidedly negative and uninteresting variety. Even those good people whom the uncompromising Scotch law describes with charming conciseness as "furious or fatuous," and delivers over to the cognizance of their "proximate agnate," must needs possess at least so much of character as is implied in the mere fact of their furiousness or their fatuity, as circumstances may determine. And furthermore, roughly speaking, no two of these characters are ever absolutely identical. The range of idiosyncrasy is practically infinite. Just as out of two eyes, one nose, a single mouth, and a chin with the appendages thereof, hirsute or otherwise, the whole vast variety of human faces can be built up, with no two exactly alike; so, out of a few main mental traits variously combined in diverse fashions, the whole vast variety of human character can be mixed and compounded to an almost infinite extent. To be sure, there are some large classes of mankind so utterly commonplace and similar that from a casual acquaintance it is hard to distinguish the individuality of one of them from that of the other: just as there are large classes of typical faces, such as the Hodge, the 'Arry, the Jemimer Ann, and the Mrs. Brown, which appear at first sight absolutely identical. But, when you come to know the Hodges and the 'Arries personally, you find that as one Hodge differs slightly from another in countenance, so do even they differ slightly from one another in traits of character and intellectual faculty. No two human beings on this earth—not even twins—are ever so utterly and absolutely alike that those who have known them familiarly for years fail to distinguish one from the other.

The problem of this difference of idiosyncrasy, indeed, is one so intimately bound up with all our ideas of our own origin and nature that it well deserves a few minutes' consideration at the hands of the impartial psychological philosopher. It has for each of us a personal interest and importance as well; for each of us wishes naturally to know how and why he happened to come by his own charming and admirable character. Yet, unhappily, while there is no subject on earth so interesting as ourselves (the one theme on which "all men are fluent and none agreeable"), there is none upon which the views and opinions of other people appear to us all so lamentably shallow and lacking in insight. They talk about us, forsooth, exactly as if—well, exactly as if we were other people. They bluntly ignore those delicate and subtile distinctions of idiosyncrasy which raise each of us, viewed with his own introspective eyeglass, into a class by himself, infinitely superior to the rest of creation.

Let us see how far we can gain any light from the doctrine of heredity on this curious question of the origin of character.

If a white man marries a negro, their children, boys and girls alike, are all mulattoes. Let us make to ourselves no illusions or mistakes upon this score: each one is simply and solely a pure mulatto, exactly half-way in color, feature, hair, and stature, between his father's race and his mother's. People who have not lived in a mixed community of blacks and whites often ignore or misunderstand this fundamental fact of hereditary philosophy; they imagine that one of the children of such a marriage may be light brown, and another dark brown; one almost white, and one almost black; that the resulting strains may to a great extent be mingled indefinitely and in varying proportions. Not a bit of it. A mulatto is a mulatto, and a quadroon is a quadroon, with just one half and one fourth of negro blood respectively; and anybody who has once lived in an ex-slave-owning country can pick out the proportion of black or white elements in any particular brown person he meets with as much accuracy as the stud-book shows in recording the pedigree of famous race-horses. Black and white produce mulattoes—all mulattoes alike, to a shade of identity; mulatto and white produce quadroon—all quadroon, and no mistake about it; mulatto and black produce sambo; quadroon and white give us octoroon; and so forth *ad infinitum*. After the third cross persistently in either direction, the strain of which less than one eighth persists becomes at last practically indistinguishable, and the child is "white by law," or "black by law," as the case may be, without the faintest mark of its slight opposite intermixture. I speak here of facts which I have carefully examined at first hand; all the nonsensical talk about finger-nails and knuckles, and persistence of the negro type forever, is pure unmitigated slave-owning prejudice. The child of an octoroon by a white man is simply white; and no acuteness on earth, no scrutiny conceivable, would ever discover the one-six-

teenth share of black blood by any possible test save documentary evidence.

Here, then, we have a clear, physical, and almost mathematically demonstrable case, showing that, so far as regards bodily peculiarities at least, the child is on the average just equally compounded of traits derived from both its parents. Among hundreds and hundreds of mulatto and quadroon children whom I have observed, I have never known a single genuine instance to the contrary. Heredity comes out exactly true; you get just as much of each color in every case as you would naturally expect to do from a mixture of given proportions. In other words, all mulattoes are recognizably different from all quadroons, and all quadroons from all octoroons or all sambos.

This simple fact, I venture to think, gives us at once the real key to the whole complex problem of idiosyncrasy and character. Every child on the average represents one half its father and one half its mother. It is a Jones in this, and in that a Robinson. Here it takes after its grandfather the earl, and there it resembles its grandmother the washerwoman. These traits it derives from the distinguished De Montmorencies, and those from the family of the late lamented Mr. Peace the burglar. But, on the whole, however diversely and curiously the various individual peculiarities may be compounded, it is at bottom a Robinson-Jones, a complex of all its converging strains, its diverse noble and ignoble ancestors. It represents a cumulative effect of antecedent causes, all of which it shares equally on the average with every one of its brothers and sisters.

How does it happen, then, suggests the easy objector, that two brothers or two sisters, born of the same father and mother, twins it may even be, "are often more unlike each other in character and mental qualities than any two ordinary strangers"? Well, the answer simply is, it doesn't happen. Make sure of your facts before you begin to philosophize upon them. Children of the same parents are always very much like one another in all essential fundamentals; they may differ a good deal among themselves, but their differences are really and truly as nothing compared with the vast complexity of their resemblances. The case of twins, in fact, is a peculiarly unfortunate one to allege in this respect, for Mr. Galton has collected an immense mass of evidence tending to show that just as twins usually resemble one another, almost indistinguishably, in face and feature, so do they resemble one another almost as narrowly in character and intellect. I know an instance myself of two twin sisters, one of whom has lived all her life in India, and the other in England, but who, in spite of this difference in circumstances, preserve so entirely their original identity of form and nature that I do not myself in the least discriminate between them in any way, mentally or physically, though they happen to be members of my own family. It does not at all matter to me whether it was Polly who said a thing or Lucy. I regard it in either

case as a simple expression of the Polly-Lucian shade of character. This is the rule in nine cases out of ten; twins are all but absolutely identical.

Still, there is such a thing as idiosyncrasy, and the reason for its existence is a very simple one. Each separate human being, it is true, is on the average an equal compound of his father and his mother, his grandfathers and grandmothers; but not necessarily or even probably the same compound. Suppose you take a lot of red and white ivory billiard-balls, say a thousand, and cast them down upon the surface of the billiard-board. Let five hundred be red and five hundred white; then every time the total result will be in one sense the same, while in another sense it will be quite different. For there will always be five hundred of each, but the arrangement will never be exactly identical; each throw will give you a new combination of the balls—a combination which will often put a totally different aspect upon the entire picture. Now, in the case of a human being you deal with infinitely more subtile factors, combined in infinitely more subtile fashions. Father and mother have each in their being myriads of traits, both mental and physical, any one of which may equally happen to be handed down to any of their children. And the traits handed down from each may not happen to be by any means always the same in the same family. Though each child resembles equally on the average both father and mother, yet this child may resemble the father in this, and that child in that; each may combine in any possible complexity of intermixture traits derived from either at random.

Here, for example, are an English father with light hair and blue eyes; a Spanish mother with black locks, an iris dark as night, and a full olive-colored southern complexion. Clearly, the children may differ indefinitely in appearance, some with darker eyes, some with lighter; some as men may grow dark-brown beards, and some may have black whiskers and hazel eyes, and clear half-Spanish dusky skin. One may have wavy hair like the mother, yet almost as light in hue as the father's; another may have it rather straight, but dark. Similarly, too, with the features. The forehead and chin may resemble the father, the nose and mouth may rather approximate to the maternal pattern. So, at least, we often say in our folly; but in reality, when we come to examine closely, we see that no single feature, even, owes everything absolutely to one parent only. Those dark eyes may indeed be Spanish in color, with a gleam of bull-fighting in their cruel depths, but they are set in the head after an English pattern, and have an English solidity of Philistine hardness. That pretty little nose may have much of the father in the bridge and the tip, but don't you catch faint hints of the mother, too, in the quivering nostril and the expanded wings? The chin recalls an Andalusian type, to be sure, but the tiny fold of flesh beneath foreshadows the fat double crease of later life derived from that old burly Lincolnshire grandfather. And so on

throughout. Not a feature of the face that is not true at bottom, in one point or another, to both its ancestries; not a shade of expression that does not recall in varying degrees some mingled traits of either parent.

The number of possible traits, then, are so immense, and the modes of their possible combination so infinite, that no two people, not even twins, ever come out exactly similar. Box and Cox are twain, not one; the Corsican Brothers are known as a pair to their intimate circle. Nevertheless, brothers and sisters do, on the whole, closely resemble one another, and this we all of us instinctively recognize whenever we talk of a family likeness. These family likenesses are almost always far stronger, both in mind and body, than members of the incriminated family itself ever care at all to recognize. It often happens, for instance, that Fred and Reginald fail to perceive the faintest resemblance between their sisters Maud and Edith. But a stranger looking through the family album (poor victimized martyr) says to Fred, as he comes upon one of their photographs, "I'm quite sure that's one of your sisters, but which is it, Miss Maud or Miss Edith?" Nay, I have even known a father himself mistake a portrait of Maud for Edith. The photograph obscured some external difference of tint or complexion, and therefore brought out in stronger relief the underlying similarity of feature and expression. It must have happened to most men to be mistaken for their own brothers by people who had never seen them before, though they themselves, looking complacently in the truth-telling glass, can hardly imagine how any one on earth could take them for such a fellow as Tom or Theodore. Tom's so very much plainer than they are, and Theodore looks so infinitely less gentlemanly. All round, in short, families resemble one another, and it is only after a considerable acquaintance with their minuter details that strangers really begin accurately to distinguish certain of their members. To themselves the differences mask the likeness, to outsiders the likenesses mask the difference.

It is just the same, be sure, in mental matters. There are family characters and family intelligences, as there are family faces and family figures. Each individual member of the brood has his own variety of this typical character, but in all its basis is more or less persistent, though any one particular trait, even the most marked, may be wanting, or actually replaced by its exact opposite. Still, viewing the family idiosyncrasies as a whole, each member is pretty sure to possess a very considerable number of peculiarities more or less in common with all the remainder. True, Jane may be passionate while Emily is sulky; Dick may be a spendthrift, while Thomas is a miser. But Jane and Dick are both humorous, Emily and Thomas both musical, Thomas and Dick both sensitive, Emily and Jane both sentimental, and all four of them alike vindictive, alike intelligent, alike satirical, and alike fond of pets and animals. Look at the persistent Tennysonian tone in Charles

and Alfred Tennyson; look at the parodying power of the two Smiths in "Rejected Addresses"; look at the Caracci, the Rossettis, the Herschels, and then say whether even minute touches of taste and sentiment do not come out alike in brothers and sisters. Almost everybody who meets brothers or sisters or cousins of his own after a long separation (when use has not dulled his apprehension of the facts) must have noticed, with mingled amusement and dissatisfaction, in ten thousand little ways and sayings how very closely he and they resemble one another. Sometimes the very catchwords and phrases they use, their pet aversions and their pet sympathies, turn out at every twist of life to be absurdly identical. One may even be made aware of one's own unsuspected and unobtrusive failings by observing them, as in a mirror, in the minds of one's relations, like King George's middy in Mr. Gilbert's story, who meets himself on an enchanted island, and considers his double the most disagreeable fellow he ever came across.

Why is it, then, that most people won't admit their own essential unity and identity of character with their brothers and their sisters, their cousins and their aunts? Vanity, vanity, pure human vanity, is at the bottom of all their violent reluctance. Every man flatters himself at heart that he possesses an immense number of admirable traits not to be found in any other and inferior members of his own family. Those spurious imitations may indeed resemble him somewhat in the rough, as coarse pottery resembles egg-shell porcelain; but they lack that delicacy, that refinement, that native grace and finishing touch of character which distinguish Himself, the cream and flower of his entire kindred, from all the rest of a doubtless worthy but very inferior family. I fancy I see you now—you, even you, my excellent critic—with that graceful cynical smile of yours playing lambent upon your intellectual upper lip, while you loll at your ease in your club armchair, and murmur to yourself complacently as you read, "The idea of identifying *me* with my brother Tom, for instance! Me, a cultivated, intelligent university man, with that stolid, stupid Philistine sugar-broker! If only I'd his wealth, how differently I'd use it! The notion's simply too ridiculous! Why, I am worth a dozen of him!" My dear sir, believe me, at this very moment your brother Tom, glancing hastily through the pages of the present paper in an interval of relaxation on his way home by Metropolitan Railway from his lair in the city, is observing with a corresponding calm smile of superiority to himself, "Ha, ha, what an absurd idea of this magazine fellow, to tell me I'm no better than my brother Jack, that briefless barrister! Jack, indeed, in the name of all that's ridiculous! If only, now, I'd had his advantages and his education—sent to Rugby and Oxford for the best years of his life, while I was stuck at seventeen into a broker's office to shift for myself and pick up my own living! And yet, what has my native talent and industry enabled me to do? Here am I at barely fifty a

wealthy citizen, in spite of all my disadvantages, while he, poor idle dog, has never been able to secure as much as a brief, with all his learning! I'm fifty per cent a better man than he is!" Vanity of vanities, saith the preacher, all is vanity.

The fact is, if we want impartially to discuss this question of characters we must each leave our own supernaturally beautiful character out of the question, and think only of the vastly inferior and ordinary characters of other people. We mustn't even allege striking instances from the history of our sisters, our cousins, and our aunts, because there, on the one hand, our calm sense of the excellence of the stock from which we ourselves are the final flower and topmost outcome is apt to prejudice our better judgment, while on the other hand our natural contempt for the gross shortcomings of our near relations under such closely similar circumstances, when compared with our own virtues and strong points, is liable to beget in us too lordly a superciliousness toward their obvious failings. It is best entirely to dismiss from consideration all the persons standing to ourselves within the list of prohibited degrees set forth in the Prayer Book, to abstain from too fond an affection for our grandmother, and to concentrate our attention wholly on the persons of that common vulgar herd of outsiders falling as aforesaid under the contemptible category of other people.

Examined from this impartial and objective point of view, then, other families beside our own show us at once how much light may be cast upon the origin of character by the study of fathers and mothers, brothers and sisters, first and second cousins, and so forth indefinitely. Mr. Galton's exhaustive paper upon the habits and manners of the common twin is an admirable example of the precise results that may be obtained by such minute and accurate objective study of hereditary peculiarities. For it must always be remembered that two brothers ought by nature to resemble one another far more closely than father and son. People often wonder why such-and-such a great man's son should not be a great man also; they ought, if logical, rather to ask why his brothers and sisters were not all of them equally great men and women. I will not insult the intelligence of the reader by pointing out to him why this should be—why the father's traits in such a case should be diluted just one half by the equal intermixture derived from the mother. For the same reason, of course, two sisters ought by nature to resemble one another far more closely than mother and daughter. Again, a son ought on the average to resemble his father in character somewhat more closely than he resembles his mother, because in the one case the identity of sex will cause certain necessary approximations, and in the other case the diversity of sex will cause certain necessary divergencies. The barber in Leech's picture explains his young customer's defective whiskers on the ground that he probably "took after his ma!" but experience shows that in such matters men usually "take after their pa" instead. Once more, for a similar reason two brothers will tend

to resemble one another, time and again, somewhat more closely than a brother and a sister. Furthermore, the two elder children and the two younger will tend to resemble one another more, as a rule, than the eldest resembles the youngest, and for a very sufficient reason, because all the habits and constitution of the two parents are liable to change from time to time, and especially after a long interval of years. Hence it will follow by parity of reasoning that two brothers or two sisters, born twins, will tend to resemble one another on the average far more intimately than do any two other members even of the same family. The rationale of this is clear. They are both the children of the one father and the one mother; they are both of the same sex; and they are both born at the same time, and therefore under exactly the same conditions of age, health, habit, and constitution on the part of both parents.

Here, then, we have a crucial instance by which we may test the physical and psychical correctness of this our general *a priori* principle. If character results in the way I say it does—if it is a product of the interaction of two independent sets of factors, derived equally on the whole from father and mother—then it will follow that, mentally and physically, twins will far more closely resemble one another than ordinary brothers and sisters do. Now, does the case of twins bear out in actual fact this debated deductive conclusion? Common experience tells us that it does, and Mr. Galton has supplemented that fallible and hasty guide by the most rigorous inductive collection of instances. The result of his investigation is simply this, that many twins do actually behave under similar circumstances in almost identical manners, that their characters often come as close to one another as it is possible for the characters of two human beings to come, and that even where the conditions of later life have been extremely different, the original likeness of type often persists to the very end, in spite of superficial variations in style or habit of living. Some of his stories, carefully verified, are very funny. I will supplement them by two of my own. In one case a couple of twins, men, had a quarrel over a perfectly unimportant matter. They came to very high words, and parted from one another in bad blood. On returning to their rooms—they lived apart—each of them suffered from a fit of remorse, and sat down to write a letter of contrition to the other, to be delivered by the morning post. After writing it one brother read his letter over, and, recalling the cause of quarrel, added at once a long postscript, justifying himself, and reopening the whole question at issue. The other brother posted his note at once, but thinking the matter over quietly, afterward regretted his action again, and supplemented it by a second palinodia, almost unsaying what he had said in the first one. I saw all three letters myself the next morning, and was simply amazed at their absolute sameness of feeling and expression.

The other story relates to a fact which happened, not to twins, but

to two successive brothers extremely like one another in build and feature, and evidently modeled in mind and character on the self-same mold. It is only a small incident, but as I can vouch for the correctness of the minute details, it has a certain psychological interest of its own. They met a lady dressed in blue, whom they had never seen before, at a military dance. Each of them asked at once to be introduced to her at first sight; each asked the same officer for an introduction (though they had several friends in common present); each described her in the same way, not as "the lady in blue" (the most obvious point of appearance about her), but as "the lady with the beautiful ears"; each fell desperately in love with her offhand; and each asked her for a particular flower out of a little bouquet containing four or five more conspicuous blossoms. Finally, each came up at the end of the evening to confide in the same married lady of their acquaintance their desire to see more of the beautiful stranger. Now, small as are all these little coincidences, they nevertheless show, to my mind, a more profound identity of mental fiber than far larger and more important matters of life could do. For, on great emergencies, or in the great affairs of one's conduct, it is only natural that somewhat similar characters, being governed by the same general emotions, should act on the whole very much alike; while often, on the other hand, a particular difference will make the action of similar characters at a special crisis extremely divergent. Thus the two Newmans, essentially the same in fiber, both re-examining their creed at a certain epoch of life, follow out their own logical conclusions with rigorous precision, one to Free Thought, the other to the Cardinalate—so that outsiders would be apt to say at first sight, "What a striking difference between two brothers!" But the exact identity of tastes and preferences shown in these minute touches of feeling—the choice of an introducer, the phrase about the ears, the selection of a particular flower (it wasn't even a violet, which might occur to anybody, but a spray of plumbago, in itself quite without sentimental interest), and the unburdening of mind to a particular confidante—all these things abundantly testify to an underlying similarity of mental structure, down to the merest side-tracks and by-ways of the brain, which could hardly happen under any other conceivable circumstances than those of actual family identity.

Still, even twins do distinctly differ in some things from one another. However much they may look alike to strangers, they are always discriminable by those who know them well, and even in early childhood by mothers and nurses. The babies who have to be distinguished by red and blue ribbons tied round their wrists, and who finally get mixed up at wash, so that the rightful heir is hopelessly muddled with the wrongful, and the junior by ten minutes preferred to his senior, belong only to the realm of the novelist; and even there we have always the well-known mark on the left shoulder to fall back upon, which inva-

riably proves the genuine title-deed to the family estates and the hand of the heroine. But, in real life, Huppim may always be readily distinguished from Muppim by some slight divergence of feature or expression; Huz is always a trifle fatter or thinner than Buz, his brother; the two Dromios and the two Antipholuses may deceive the outer public by their close resemblance, but not even Shakespeare himself can make us believe that Mrs. Antipholus was really mistaken as to the personal identity of her own husband. I don't want to be too hard on a lady, but I fancy, myself, she was glad of the excuse for a little innocent and easily explicable flirtation with an agreeable stranger.

Yes, everybody has a character and an idiosyncrasy different in many points from everybody else's. Not even twins, who come closest together of all humanity, merge their individuality absolutely into mere replicas one of the other. Such utter identity is quite impossible in the human family. And the reason, I think, is simply this: the infinite number of separate traits possessed by each human being is too immensely incalculable ever to admit of any two throws, however near, producing precisely the same resultant. I do not doubt that there may be snails or jelly-fish built absolutely on the same pattern in every particular, mental or physical; though, even there, the man that knows them well is often astonished at the way in which one snail differs from another in aspect, or one jelly-fish differs from another in character and intellect. But while the papa snail and the mamma snail are distinguishable in a few traits only, discoverable by none but the close observer, the papa and mamma among human beings are distinguishable by ten thousand diverse peculiarities, mental and physical, all of them obvious to the veriest outsider. Each child is, as it were, a meeting-place and battle-field for these diverse paternal and maternal tendencies. It must resemble one or the other in every fiber of every feature; it can't possibly resemble both exactly in those points in which they conspicuously differ. Hence the resultant is, so to speak, a compromise or accommodation between the two; and the chances of the compromise being ever absolutely equal in any two cases are practically none. You might throw down the letters of the alphabet which compose "Paradise Lost" for ever and ever, but you would never get even one line by accident in the exact order that Milton wrote it. In the struggle for life between each unit or cell that goes to make up brain and face and nerve and muscle, here the father conquers, and there the mother, and yonder a truce is struck between them; but that any two among the children should ever represent exactly the same result of the desperate struggle is so infinitely improbable as to be practically impossible.

One last word as to the difficulty which some observers doubtless find in making this theory fit in with the facts as they observe them. While writing this paper, I paused in the midst, laid down my pen,

and went from my study into the adjoining room for an intercalary cup of five o'clock tea with the members of my family. (After all, we are all vertebrate animals and human beings; why attempt to conceal the fact out of consideration for the dignity of literature?) The talk turned, as it often does turn under such circumstances, on the subject about which I had just been writing. I expounded these my views on the origin of character to the attentive ears of a critical domestic audience. To my utter dismay and discomfiture, I found that they of mine own household were firmly opposed to me. "Why," said the person, who, of all others on earth, ought to back me up most surely in my worst heresies, "look at So-and-so and So-and-so! You know they're twins; and yet how utterly unlike one another they are in character!" Now, will you believe me, as it so happened, So-and-so and So-and-so were two of the very cases on which I most relied in my own mind when making some of my present generalizations about twins and their identity! This, of course, conclusively shows that people sometimes differ in opinion. Some of us see differences more acutely, and some of us likenesses. To some of us the So-and-so family are all as like as two peas; while to others of us there is absolutely nothing common to all of them. Depend upon it, neither side is right; the So-and-so's are in some ways very much alike, and yet in other ways very different. The family face and the family character run pretty impartially through them all; but each wears it in his own fashion and with his own special combination of peculiarities. One side has a keen eye for the resemblances; the other has a keen eye for the differences. Mr. Galton's method, by taking the mean of many observations, effectually gets rid, so far as possible, of this little natural "personal equation."

A single example will make this matter clearer than pages of abstract argument could make it. One of the instances I cited above was that of two brothers so identical in fiber that each did exactly the same thing, at times, with exactly the same minute touches of feeling and expression. They recognized the absolute identity themselves; it was often to them a cause of some laughter, and not infrequently of some confusion and suspicion also. Each knew a trifle too well what the other was likely to do and think of. Yet I have on paper a letter from one of their acquaintances, saying, in so many words, "James has been staying here for some weeks; we like him very much, indeed, but oh, how different he is from *our* Mr. Trois Etoiles!" Now the fact is, that was probably the judgment of every one everywhere who knew them both only superficially. The younger brother, whom I have ventured here to call James, because James is a good solid Christian name, implying honest industry and business ability, had been put to work at his father's occupation early in life, and was known to most men as a quiet, sober, steady-going man of affairs. The elder brother, whom I will christen Percy, because the name Percy

has a fine literary flavor about it, and suggests either Shelley or the reputed author of Aytoun's "Firmilian," according to the taste and fancy of the reader, had been sent, as the heir of the house, to Cambridge, and having there acquired the habit of literature, took to journalism and other reprehensible pursuits, and sank at last into a confirmed scribbler. The world at large always said that Percy was a very clever fellow, while that man James had absolutely nothing at all in him. His entire interest was absorbed in the tea-trade. We who knew them both well, however, could clearly discern that the mere difference of position and education masked in James the very characteristics that were plainly developed and abnormally nurtured in his brother Percy. And Percy often said to me in confidence, after eleven o'clock at night, as we sat together over our glass of whisky-toddy, "If James had only been sent to Cambridge, he'd have been a deal cleverer fellow than I am." It may have been rude of me, but I always agreed myself with Percy.—*Cornhill Magazine.*

SKETCH OF DAVID AMES WELLS.

DAVID AMES WELLS has long been the representative economist of the United States, and a thinker whose vast information, fearlessness, and thoroughly judicial mind, have won him fame among economists the world over. He has proved his ability and sagacity in the successful management of large business interests. While most economic teachers have been confined to class-room and text-book, it has been his exceptional good fortune to practically apply his science to the reform of fiscal errors. Since vacating his high office under the Federal Government, he has exerted wide and growing influence upon the legislators of the nation.

Mr. Wells was born in Springfield, Massachusetts, June 17, 1828, and is a lineal descendant on the father's side of Thomas Welles, Governor of the Colony of Connecticut, 1655–1658, and on the mother's side of David Ames, who, under Washington, built and established the National Armory at Springfield. He and his brother Oliver were the founders and progenitors of the well-known manufacturing and railroad-building family of Massachusetts. After graduating at Williams College in 1847, and writing and publishing his first book, entitled "Sketches of Williams College" David Ames Wells was for a time (1848) an assistant editor with the late Samuel Bowles of the Springfield "Republican." While thus employed, Mr. Wells suggested the idea, and was associated in the invention, of folding newspapers and books by machinery in connection with power printing-presses; and the first machine ever constructed and success-

fully operated was built at his expense and worked under his direction in the office of the "Republican." Having, however, a taste for scientific pursuits, and being now in the possession of some means through the sale of his interest in the above invention, he quitted the pursuit of journalism, and in 1849 entered the Lawrence Scientific School of Harvard University, becoming also at the same time a special pupil of Professor Agassiz, who had then recently arrived in this country. Graduating in the first class that completed a course of study in the Scientific School in 1851–'52, he immediately received the appointment of assistant professor in this institution and also that of lecturer on physics and chemistry in Groton Academy, Massachusetts. During his residence in Cambridge, Mr. Wells, in association with George Bliss (late United States District Attorney for New York), commenced in 1849 the publication of an annual report on the progress of science and the useful arts, which, under the name of the "Annual of Scientific Discovery," was continued for many years.

Between 1857 and 1863, Mr. Wells was engaged in the preparation of a series of scientific school-books, which at one time attained a very extensive circulation, two of the series having been translated by missionaries into the Chinese language, while a third—an elementary treatise on chemistry—was adopted as a text-book at West Point.

Mr. Wells, however, first came prominently into public life in 1864, while residing in Troy, New York, through the publication in that year of an essay on the resources and debt-paying ability of the United States, bearing the title of "Our Burden and Strength." This essay was first read at a literary and social club in Troy, then published privately, then reprinted and circulated by the Loyal Publication Society of New York, and, receiving at the same time the approval of the Federal Government, it became one of the most noted publications of the war period. It was reprinted in England and translated into French and German, and had a circulation which is believed to have been in excess of two hundred thousand copies. Coming at a period when the nation was beginning to be alarmed at the prospective magnitude of the public debt, and apprehensive of an impending crushing burden of taxation, its publication and circulation proved a most effective agency for restoring public confidence and maintaining the credit of the Federal Government.

The perusal of this pamphlet made a great impression upon President Lincoln, and in January, 1865, he sent for Mr. Wells to come to Washington and confer with him and Mr. Fessenden, then Secretary of the Treasury, on the best methods of dealing, after the termination of the war, then evidently at hand, with the enormous debt and burden of taxation that the war had entailed upon the nation. The result of this conference was the passage by Congress of a bill, in March, 1865, creating a commission of three persons for the purpose of inquiring

into and reporting "on the subject of raising by taxation such revenue as may be necessary in order to supply the wants of the Government, having regard to and including the sources from which such revenue should be drawn, and the best and most effectual mode of raising the same." Of this commission, Mr. Wells was appointed chairman by the then Secretary of the Treasury, Hon. Hugh McCulloch; and its report in 1866, which was mainly the work of Mr. Wells, presented for the first time a full and exact statement of the curious and complex system of internal and customs revenue which had grown up during the war, when the necessities for raising immense sums of money with the utmost promptness and regularity were so great as to transcend all ordinary considerations, and justify the maxim, "Whenever you find an article, a product, a trade, a profession, or a source of income, *tax it.*" How wonderfully successful this system of taxation proved, is shown by the circumstance, that for the last year of its full operation —1865–'66—it yielded from internal-revenue sources alone $310,000,000, and from internal revenue, customs, and other sources, the aggregate sum of $559,000,000, drawn from a tax-paying population not much in excess of twenty-two millions. In addition to this feature of the Revenue Commission Report in 1866, it also contained elaborate reports on sugars, tea, coffee, cotton, spices, proprietary articles—patent medicines and the like—petroleum, fermented liquors, and distilled spirits as sources of revenue, with estimates as to the amount of revenue which the Treasury might expect if taxation on them, at various rates, was to be continued; the whole being really the first practical attempt in the United States to gather and use national statistics for great national purposes.

On the termination of the Revenue Commission in January, 1866, by limitation of service, Congress was so well satisfied with the work that Mr. Wells had performed, that he was immediately appointed, for a term of four years, to an office created for him, under the title of "Special Commissioner of the Revenue," the duties of which were thus defined by the enacting statute: "He shall from time to time report, through the Secretary of the Treasury, to Congress, either in the form of bill, or otherwise, such modifications of the rates of taxation, or of the methods of collecting the revenues, and such other facts pertaining to the trade, industry, commerce, or taxation of the country as he may find by actual observation of the operation of the law to be conducive to the public interest."

In this office, and invested with large powers, Mr. Wells entered with ardor upon the work of reconstructing and repealing the complex system of internal taxation, which had become terribly oppressive, and the longer continuance of which had become unnecessary; and, under his initiation and supervision were originated nearly all the reforms of importance in our national-revenue system—internal and customs—that were adopted by Congress between the close of the war in

1865 and the year 1870, namely: the redrafting of the whole system of internal-revenue laws, the reduction and final abolition of the cotton-tax, and the taxes on manufactures and crude petroleum; the creation of supervisory districts and the appointment of supervisors; the origination and the use of stamps for the collection of taxes on tobacco, fermented liquors, and distilled spirits, and the creation of the Bureau of Statistics. To the head of this Bureau Mr. Wells called, from the office of the Springfield "Republican," its assistant editor General F. A. Walker; and under his management the Bureau was first efficiently organized.

In one of his earliest official reports, Mr. Wells took earnest ground against the attempt to collect a tax of two dollars per gallon, or 1,000 per cent on the first cost, on distilled spirits, and maintained that fifty cents per gallon was the rate of tax certain to be the most productive of revenue, and little oppressive to manufacturing industries. This report, made in 1866, although attracting much attention, by reason of its detailed narration of the singular experiences of the Government in attempting to enforce so high a tax, found little favor in respect to its recommendation for tax abatement. But, in the winter of 1867–'68 Congress, becoming alarmed at the increasing frauds, and steadily diminishing receipts of revenue, acceded to Mr. Wells's recommendation and fixed the tax at fifty cents per proof gallon. The result was one of the most remarkable in all economic or fiscal experiences, for the total collections rose at once from $18,665,000 during the last year of the $2 tax in 1867–'68, to $45,071,000 in the first year of the 50-cent tax, 1868–'69, and to $55,606,000 in the succeeding year, 1869–'70; a gain to the Government in two years of over sixty millions of dollars in revenue, with great diminution of fraud and great relief to the industries of the country.

Up to the year 1867, Mr. Wells, who was born and reared a member of one of the largest manufacturing and Whig families of New England, was an extreme advocate and believer in the economic theory of protection. In 1867, Congress having instructed the Secretary of the Treasury to present at its next session a draft of a new tariff looking to reductions of war-rates, and the business of preparing the same having been turned over to the office of the Special Commissioner, Mr. Wells, with a view of qualifying himself for the work, visited Europe under a Government commission, and investigated, under almost unprecedented advantages, nearly every form of industry, competitive with the United States, in Great Britain and on the Continent. The results of this visit and investigation enlightened him in respect to two salient and fundamental points: *First*, that no country, with the exception of the United States, which had adopted in a greater or less degree the policy of protection through duties or restrictions on imports, had ever regarded the taxation of the importation of crude, or partially manufactured articles to

be subsequently used for larger manufacturing, as a feature of protection to its domestic industry, but rather as antagonistic to and destructive of such industry; and that while such taxation in the United States had undoubtedly built up some industries and enriched their owners, it had been a great restraint on the development of a much larger and higher class of industries, employing many more workmen and paying much higher average wages; a taxation imposed then and now, for example, of from thirty to forty millions per annum on the importation of crude and partially manufactured articles, being a tax of ten per cent on a product of three or four hundred millions of finished products, thereby excluding them from all sales in the markets of the world, in competition with similar products not subject to such price enhancement. And, *second*, that the countries of Europe—like Russia and Austria—in which the average rates of wages are lowest, were the most clamorous for protective duties on foreign imports; and that high wages in any country, conjoined with the extensive and skillful use of machinery, instead of being evidences of industrial weakness, were evidences of great industrial strength; inasmuch as no employer can continuously pay high wages unless his product is large, his labor most effective, and his cost of product, measured in terms of labor, low. These personal experiences in respect to European industry, coupled with a subsequent study of our customs system, and a complete redrafting of our whole tariff rates under instructions from Congress through the Secretary of the Treasury, gradually, and greatly against all his preconceived ideas, led Mr. Wells to a complete abandonment of his original position as a strong protectionist, and to the adoption of the belief that free trade, made subordinate to revenue and progressively but tentatively entered upon, was for the best interest of the whole country.

The announcement of these views, and especially the publication of his report for 1869, created great opposition among the protectionists, and Horace Greeley publicly charged that Mr. Wells had been corrupted through British gold distributed through the agency of Mr. A. T. Stewart. Mr. Stewart, exceedingly angry at being brought into this matter, desired that Mr. Wells should at once institute proceedings for libel, and several leading members of the New York bar volunteered to take charge of the case. But Mr. Wells felt that it was not necessary to vindicate his public or private character by any such action, and refused to become a party to it. The story, nevertheless, found extensive credence, and is undoubtedly believed by many persons at the present time who are unable otherwise to account for such a change in the economic opinions of the Commissioner so shortly after his return from Europe.

A draft for a very complete revision of the tariff, prepared by Mr. Wells in accordance with instructions, together with a full and

elaborate report on the existing revenue resources and condition of the country, submitted to Congress through Secretary McCulloch, and with his hearty indorsement, in December, 1867, nevertheless found great favor, and, embodied in a bill, with slight modifications, came very near being successful. The Senate passed it by a vote of 27 to 10. In the House it failed, in the closing hours of the session, by a very few votes—and not by a direct vote, but on a motion to suspend the rules, take the bill from out the Committee of the Whole, and "put it on its passage." This motion, which required a two-thirds vote, was defeated—106 in the affirmative to 64 in the negative. It was thus made evident that, could the bill as it came from the Senate have been brought directly before the House, it would have passed by a large majority, and probably have quieted for years all tariff agitation.

When the office of Special Commissioner expired by limitation in 1870, President Grant, giving the personal dislike of the Secretary of the Treasury at that time—Mr. Boutwell—to the Commissioner as a reason, refused to reappoint Mr. Wells in case of a renewal of his office. On his retirement in July, 1870, a large number of members of both Houses of Congress, without distinction of party, united in a letter headed by Messrs. Sumner, Trumbull, Carpenter, Henry Wilson, Buckingham, Anthony, Thurman, Schurz, Bayard, Edmunds, Fenton, and others, on the part of the Senate, and Messrs. Blaine, Garfield, Logan, Allison, Cox, Hooper, B. F. Butler, Kerr, Dawes, Eugene Hale, Banks, Poland, Oakes Ames, Niblack, Randall, Brooks, Beck, J. A. Griswold, James Brooks, A. A. Sargent, J. F. Wilson, F. Wood, Noah Davis, D. W. Voorhees, W. H. Barnum, and others, on the part of the House—of which the following is an extract: "The undersigned, members of the Forty-first Congress, who have been cognizant of your labors as Special Commissioner of the Revenue, take the occasion of your retirement from public duties to express to you their appreciation of the work you have accomplished, and the great ability with which you have discharged the duties of your office. How much soever they may perhaps have differed with you touching the matter of your conclusions upon particular points, they desire nevertheless to bear testimony to the great value of your work, and to the honesty and the faithful and untiring zeal which have characterized your whole public career." At the same time a committee of citizens of different States, members of both parties, presented to Mr. Wells several testimonials of great value; one of which, a superb bronze statuette, some thirty inches high, representing "Labor," in the form of a fully-developed workman, leaning upon his sledge-hammer, bears upon a silver plate the following inscription:

PRESENTED TO

Hon. DAVID A. WELLS,

ON HIS RETIREMENT FROM THE OFFICE OF SPECIAL COMMISSIONER OF THE REVENUE, BY CITIZENS OF NEW YORK AND NEW ENGLAND, AS A TOKEN OF ESTEEM FOR HIS UNSULLIED INTEGRITY AND HIGH PERSONAL CHARACTER; AND AS A SLIGHT RECOGNITION OF HIS INESTIMABLE SERVICE TO HIS COUNTRYMEN.

Commenting on the discontinuance of the office of Special Commissioner of Revenue, the "North American Review" used at the time the following language: "The system of taxation, by which the Government has been in receipt of its enormous income, was established during the war; and the man who deserves the most credit for its reform is Mr. David A. Wells, whom General Grant and Secretary Boutwell united in bowing coldly out of the public service. It was he who proved the capacity of the country to stand an enormous taxation, and pointed out the most convenient and legitimate sources of revenue; and the most continuous changes and improvements in our revenue system, including even those under the Administration that dismissed him, were but the following out of the suggestions and the line of argument which he had presented while in the Treasury Department. To him and to Congress, and to a generous and patriotic people, does the country owe the proud exhibition of debt and tax reduction."

General Garfield, in a debate in the House of Representatives, July 13, 1868, also paid the following handsome tribute to the work of Mr. Wells as Revenue Commissioner, saying: "I do not believe that any man appointed by the Government in the civil service has done for this country more work, and more valuable work, than David A. Wells. Into the financial chaos resulting from the war he threw the whole weight of a strong, clear mind, guided by an honest heart, and during the last three years he has done more, in my judgment, to bring order out of chaos than any one man in the United States."

As soon as it was known that Mr. Wells was to retire from his office at Washington, the appointment as chairman of a State commission for investigating the subject and the laws relating to local taxation was tendered him by the Governor (Hon. John T. Hoffman) of the State of New York and accepted; and in this new position Mr. Wells prepared and submitted to the Legislature two reports (in 1872 and 1873) and a draft of a code of laws. Both of these reports were subsequently reprinted in the United States and in Europe; and one of the first acts of the French Minister of Finance (M. Wolowski), after the conclusion of the Franco-German War, was to order the translation and official publication of Mr. Wells's report as Special Commissioner of Revenue for 1869. This compliment was further supplemented in the spring of 1874 by the election of Mr. Wells, by the French Acad-

emy, to fill the chair made vacant by the death of John Stuart Mill, and also in the same year by the voting to him of the degree of D. C. L. by the University of Oxford, England. The honorary degree of LL. D. had been previously given to him by the college of his graduation (Williams), and that of M. D. by the Berkshire Medical College in 1863. In 1873, on invitation of the Cobden Club, Mr. Wells visited England and delivered the address at the annual meeting and dinner of the club. In 1872 he was invited to lecture on economic subjects at Yale College. In 1875 he was elected President of the Democratic State Convention of Connecticut; and he has served twice as delegate at large from Connecticut to Presidential nominating conventions, i. e., in 1872 and 1880. In 1876, Mr. Wells, after refusing to accept a regular nomination for Congress in the third district of Connecticut, was put upon the course by resolution of the Democratic convention, with the result, in the face of conditions otherwise wholly favorable to the Republicans, of reducing a hitherto impregnable Republican majority from 1,176 to 40.

In 1870 Mr. Wells was elected a member of the Cobden Club; in 1871, honorary member of the Royal Statistical Society of England; in 1875, President of the American Social Science Association, succeeding Dr. Woolsey, of New Haven; in 1877, a foreign associate member of the Regia Academie dei Lincei, of Italy; in 1880, President of the New London County (Conn.) Historical Society; and in 1881, President of the American Free-Trade League. In 1878, Mr. Wells was appointed by the President a member and subsequently elected President of the National Board of Visitors to the United States Military Academy at West Point. In 1876 he was appointed by the United States court one of three trustees and receivers of the Alabama and Chattanooga Railroad, and in the course of the following fourteen months rescued the corporation from bankruptcy, and expended a considerable sum for improvements and repairs, without incurring an additional dollar of indebtedness. In 1877 he was appointed by the State Board of Canal Commissioners chairman of a commission to consider the subject of tolls on the New York canals, and in the next year made an exhaustive and acceptable report.

In 1879, in connection with the late E. D. Morgan, of New York, and J. Lowber Welsh, of Philadelphia, and as trustees of the bondholders, he bought under foreclosure and sale, and reorganized the New York and Erie Railroad, and served for some time as a member of the finance committee of the board of direction of the new company. In 1879 he was elected by the associated railways of the United States, in connection with Charles Francis Adams, of Massachusetts, and John M. Wright, of Philadelphia, a member of a board of arbitration, to which the associated railroads agreed to refer all their disputes and all arrangements for pooling or apportioning their respective competitive

earnings. For two years the efforts of this board were successful and acceptable; but, at the commencement of the third year, from causes to which the board was not a party, arbitration was refused by certain roads, and the arrangement was first suspended, and finally terminated. Pending final action as to the continuance of the board, Messrs. Wells and Adams voluntarily relinquished the sum of ten thousand dollars each, that was due them, on the ground that no service having been required of them or given, they were not honorably entitled to compensation for doing nothing.

During the last twenty years few Americans have written and spoken more frequently and more acceptably to the public on subjects connected with the industry, commerce, finance, shipping, railroads, taxation, and labor of the country, than Mr. Wells; and some of his productions in pamphlet form, as "The Primer of Free Trade," "Why we Trade and How we Trade," and "The Dollar of the Fathers *vs.* The Dollar of the Sons," have attained a wide circulation. Of books, the following are well known: "Robinson Crusoe's Money," illustrated by Nast, or the experiences of an island people in using different kinds of money, 1876; "Our Merchant Marine; How it Rose, Increased, Became Great, Declined, and Decayed," 1882; "Practical Economics," 1885; "A Study of Mexico," 1887. Concerning the latter work, M. Romero, the Minister of Mexico to the United States, writes: "Although I differ with you on several points, and in respect to some of your conclusions, it is surprising to me how well you have understood the condition of Mexico and its difficult problems, especially so far as its relations with the United States are concerned." To which the Rev. George B. Hyde, one of the leading and oldest missionaries of the Methodist Episcopal Church in Mexico, adds, under date, at the Mission of Puebla, of May, 1887: "I have, I think, read all works of importance relating to the social and political economy of Mexico; and the 'Study' is the only one that has not either looked with eyes that saw a paradise or a desert. I consider the book the most valuable yet published on the real condition of Mexico."

The series of papers "On the Economic Disturbances since 1873," now publishing in the "Popular Science Monthly," being also reprinted concurrently in Europe, are regarded both in this country and Europe as among the most instructive and valuable contributions that have been made in recent years to any department of economic science.

Mr. Wells's present residence is at Norwich, Connecticut, where he is the owner of one of the most pleasant old-fashioned houses in New England, and one of the best private economic libraries in the country.

CORRESPONDENCE.

INDIVIDUALITY IN OUR SCHOOLS.

Editor Popular Science Monthly:

BY the common consent of mankind, individuality is considered one of man's highest characteristics. During the early history of the republic, it was a much more common possession of our people than at the present time. In looking for the causes that have produced this loss of a prominent trait, the mind involuntarily stops to dwell upon our system of grading in the common schools of the country. By this system there is established a level to which it is believed all can attain. I am willing to concede that it tends to stimulate the dull scholars to rise to a higher level than they would naturally reach; but unfortunately it also prevents the bright ones from going forward to higher standards. It is said that the greatest good to the greatest number is the desired object, but this is a false statement of the facts, for it is to the bright scholars that we must look to finally carry all to higher attainments. This system of grading at once prevents the working out of the law of evolution; and we may truly assert that some, at least, of the graduates of our schools have reverted to common types, instead of developing to ever-higher standards. We can not stand still: if the scholars in our common schools do not go forward, then there is reversion. The world goes on and leaves them.

Perhaps the most glaring fault of the system is, that it turns out graduates with minds all cast in the same mold. Many of them are bright and capable young men and women, but they have been so educated that the girl graduates all want to be teachers, or marry rich men for a career in life, with now and then one who enters the pulpit or the medical profession; while the male graduates seldom see any other career open to them than law or medicine, with now and then one that enters the pulpit. At the same time the services of these young men are in demand as surveyors or engineers upon our railroads, and in the new avenues of employment created by the many wonderful recent inventions, especially in handicraft and industrial pursuits. It is just here that our schools are deplorably deficient. They ought to educate the hand as well as the head of the pupils, for industrial employments must, in the end, be the life-work of the majority of them. There is one lesson of the late civil war that I think has not been properly studied. The Southern States have never made use of graded schools, or had not done so before the war of the rebellion. That there was far more individuality in the South than at the North the history of the war abundantly shows. The Southern people had a surplus of able commanders for their armies, while we of the North, with resources and numbers far superior to theirs, saw our armies turning from one point of the compass to another, making no progress, because our commanding generals were routine men, most of them graduates of our common schools, without the ability and genius for command, or foresight to plan a great and comprehensive campaign. We made little or no progress until President Lincoln, a grand, self-educated Western man, saw the reasons of our constant defeat, and changed his commanders from Eastern common-school graduates to Western men, who had been trained in the non-graded, log-housed schools of the West, where the individuality of the pupils had not been repressed by this dwarfing process.

We sometimes hear a phrase in New York and in the New England States, "The Ohio idea," and there are often an inflection and a tone of the voice indicating contempt in connection with it. The tone and inflection are nothing but the same sneer that was observed during the civil war upon the countenances of these Eastern common-school graduates when Mr. Lincoln turned them out, and put Grant, Sherman, and Sheridan in their places. The meaning of "the Ohio idea" then was individual development in contrast with the system of repression in the common schools of the East; for in Ohio, previous to the war, there had been but little of that grading process now conforming the schools of the West to Eastern standards. Would it not be well for our educators to study this topic, and try to find out a system that develops the individual as an individual, and not as one of a class or grade? Individuality can not be repressed without final disastrous results. The system of common schools of a State that developed Grant, Sherman, Sheridan, McPherson, and Garfield was not paralleled by any State in the East, where graded schools have existed the longest. In short, the point that I desire to present is that it is a violation of individual and natural rights for the State to make one individual smaller that another may be larger. General Grant was worth more to the nation than an army of common men.

D. S. MARVIN.

WATERTOWN, NEW YORK, *February* 25, 1882.

THE "LONG AND SHORT HAUL."

Editor Popular Science Monthly:

In the correspondence department of your March number is a note from Mr. Thomas L. Greene, in which he questions the accuracy of some statements contained in my article in the February "Monthly." I admit that the ill effects of the long and short haul section are not apparent in cases where its enforcement is suspended. My criticism was written some six months since, and before the policy of the commission of granting "temporary relief" had become so well defined as has since been the case. At that time the assumption seemed warranted that that law (like all other laws) was to be generally enforced. The exercise of "temporary relief" (permission to violate), which it is optional with the commission to apply or withhold in specific cases, places a tremendous power in its hands, and only the fact that its present members are incorruptible insures present safety. All *law*, theoretically, is general, impartial, and just in principle, but when its enforcement or violation is left optional with any tribunal, however competent, there is danger ahead. It would be unique to include among the *merits* of a law the easy facilities for its violation.

HENRY WOOD.

BOSTON, *March* 2, 1888.

"THE TIME OF FIGS."

Editor Popular Science Monthly:

In my letter, which you published in the March number, my main object was to state the fact that the fig-tree in southern Palestine should have figs in some stages of development on it at all seasons, though it is a fact that, in some varieties of figs, the fruit is a long time in ripening. The fruit of three seasons is sometimes found on the tree at the same time. It is true that one of the evangelists states that "the time of figs was not yet." That remark can only mean—as nearly all commentators interpret it—that the time of general harvest of figs for preserving purposes had not yet arrived; consequently, it was an additional reason for the condemnation of the fruitless tree, instead of a reason why it should not be condemned.

J. W. HUNTOON, M. D.

LOWELL, MASS., *March* 1, 1888.

EDITOR'S TABLE.

SCIENTIFIC HABITS OF THOUGHT.

IT is a question well worth considering, how scientific habits of thought are best to be formed, maintained, and strengthened. Such is the prestige of science in the present day, so thoroughly is scientific reasoning recognized as the type of all true reasoning, that nobody with any pretensions to intelligence would wish to be accused of thinking unscientifically. At the same time there is a vast amount of unscientific thinking being done on every hand; and men of almost every grade of culture may be found, the tone of whose minds is unscientific to the last degree. Let us see if we can throw into some kind of acceptable shape the general principles to be observed by whosoever would be saved from irrationality and a spirit of opposition to the truth—whosoever would wish to have scientific habits of thought in the best sense.

It is probably correct to say that science was first forced upon men's minds by the repeated presentation of the same phenomenon with an unvarying accompaniment of antecedent and consequent. Without entering upon a discussion of the nature of our conception of cause, we may say that science is nothing else than a knowledge of the permanent relations, whether causal or other, of things to one another. Nature, in the first place, forces us to recognize certain uniformities: some minds not only learn the particular lesson so taught, but, entering into the spirit of Nature's teaching, run on to discover further uniformities for themselves. These, to whatever age they belong, are the scientific spirits of their time. Others there are who look upon every such lesson as an infringement of their natural liberty to think and believe without any reference to the bounds of law. These learn only what they must, and, beyond the region of palpable and irresistible demonstration,

love to indulge the most wayward and fantastic beliefs. In these we see the enemies of science, unwilling learners in Nature's school, rebellious spirits who fain would fashion the universe to their own liking. The first condition, therefore, of scientific thinking is to recognize and to bow to Nature as the supreme teacher, and to feel that she has an inexhaustible fund of wisdom to impart. He who thinks scientifically recognizes no authority save that of demonstration. He gladly avails himself of the help of superior minds, but he does not swear by their words; for, great as they may be, and as he may acknowledge them to be, he can not regard them as infallible. Partisanship in science is almost a contradiction in terms. The expression "schools of thought" even is one to be accepted with caution; seeing that no one should wittingly attach himself to any school save the great school that Nature keeps ever open to all. Too much emphasis, indeed, can hardly be laid upon this view of the matter. The pursuit of truth partakes of the character of a religion; and the mind that is imbued with the religion of science never for a moment places any human authority, however great, in the place of the truth which, by no violent figure of speech, he may be said to adore. Truth has its ministers, but it has no priests, no class of men whose mere office summons to reverence. We ask respecting the ministers of truth simply how much of its illumination they have received, how much they are able to impart; and we honor them in proportion to the clearness and strength of their thought and the fruitfulness of their labors.

The more we dwell upon and develop the thought of Nature as the teacher, the more we see that the whole of scientific thinking depends upon loyalty to this one source of light. Every unscientific attitude of mind or movement of thought we ever heard of has had, for its main characteristic, an ignoring of Nature and a following after idols whose power was supposed to be superior to Nature. In all ages men have more or less resented the blessed bonds that have made them captive to earth and to its laws. Because their thought could traverse the heavens, and because their imagination could conjoin the most opposite elements and conditions, they have sighed after equal liberty for their active powers, and have run eagerly after whatever promised to emancipate them from the ordinary conditions of life. Hence the fanaticisms that have possessed and oppressed mankind; hence most of the delusions to which they have fallen subject; hence the scorn that, under certain systems of thought, has been, and is still, cast upon this present life; hence the prevailing indifference to, and depreciation of, what claims no higher sanction than natural or human law.

In the study of Nature there is one caution to be observed, and that is that absolute truth is not to be expected. Nature is willing to teach us, but she treats us like the children we are, using the symbols best suited to the range of our comprehension, but not laying bare her ultimate secrets. A large part of the scientific temper consists in recognizing this. He who imagines that, because he has made a generalization under which a certain group of facts can be advantageously presented and explained, he has struck the rock-bed of eternal truth, is a scholar rather pert than solid, and Nature will probably rebuke him some day. Newton knew well that in his great generalization he had merely succeeded in measuring a force the real nature of which it was wholly beyond him to explain; and the greatest scientific intellects of the present day are precisely those that most fully acknowledge, because they most deeply feel, the merely provisional character of the most important scientific hypotheses.

A third note of the scientific mind is practicality of view. The highest reverence for truth is not inconsistent with a desire to put truth to practical uses. Nature is the supreme teacher, and yet, from a certain point of view, Nature may be said to exist for us, not we for Nature. We lay hold of her phenomena with a masterful grasp, and read laws into them, reserving to ourselves the right to read ever wider and higher laws as our knowledge widens. And when our minds are in free and unrestrained movement, and are being built up in symmetry and strength by what they absorb in the study of external things, we feel that the highest work of which we can form any conception is being accomplished. There are scientific workers whose whole ambition seems to be to form a kind of *hortus siccus* of observations and opinions, and whose own minds are but little transformed by the knowledge that passes through them. These lack the true scientific spirit, though their work may at times have its uses. They lack the joy of growth, and never realize the sense, at once of liberty and power, which those possess who look upon nature, not as a mere curiosity-shop or museum, but as a vast domain providing all that is necessary for the exercise, aliment, and discipline of the human mind.

The truly scientific spirit, we may lastly say, is essentially inductive. It feels its way into truth by slow degrees. If facts are at all accessible, it does not care to depend on hypotheses; and it is always ready to accept the yoke of facts—never tries to put a yoke on facts. In this respect it differs greatly from the disposition shown by many radical thinkers of to-day, who, having thrown overboard their former theological opinions, are none the less governed in their daily thinkings by old theological methods. Such confidence have these persons in their argumentative that they never seem to care to freshen their thought with new knowledge. Such and such are the cardinal principles in which they believe, and from these they are prepared to draw an ever-lengthening chain of conclusions, all, as they hold, of absolute certainty because the starting-point was, in their opinion, indubitably true. No man, however, who has a glimmering of the scientific spirit cares to follow this kind of dead-reckoning. "He to whom the Eternal Word has spoken," says a famous mediæval sage, "is set free from many opinions." So he, we may say, to whom Nature has spoken in intimate tones, who knows what it is to have studied Nature patiently and faithfully, is freed from all bondage to mere opinions by his supreme attachment to truth. His great interest lies in knowing what is, not what, according to somebody's way of looking at things, ought to be.

We may know the man, therefore, whose habits of thought are scientific by his abiding faith in the teachings of Nature; by his unshaken conviction that the uniformities we see in the occurrence of phenomena are but hints of the universal constancy of natural law; by his interest in all that can be brought under law, and lack of interest in all alleged lawless and abnormal manifestations; by his recognition of the inaccessibility of absolute truth, and his willingness to make the best of provisional theories and symbols; by his freedom from pedantry and dilettanteism; by his reverence for human nature; by his constant desire for the verification of opinions, and his consequent freedom from all infatuation, whether for the theories of others or for his own. He is a man whose moderation is known to all men, whose patience seems to have been learned from Nature herself, whose thought moves from year to year in larger circles, and whose character bears witness to the liberal and elevated character of his daily occupations. Do all men of science, all professors of philosophy, conform fully

to this type? No, but this is the type to which, in so far as they are true to the spirit of philosophy and science, they will all, gradually, more and more conform.

DEATH OF PROFESSOR GRAY.

The death of Asa Gray removed a student who was looked up to in all the world of knowledge. In many aspects he had no master, and there were few who could be regarded as his peers. In his special field his leadership was recognized—in all nations. The help and sympathetic co-operation he gave to Darwin in building up the doctrine of variation and natural selection show him to have been a pioneer in the advance of science as a whole. His success in presenting the details of what was considered one of the driest of scientific subjects in such a way as to make his treatises as readable as a book of travels entitles him to a high position in literature. The company of American botanists who, having drunk their inspiration from his books, are carrying on their work in a like spirit, are a testimony to his powers as a teacher. And the Church, when it has purged itself from the heresy that every discovery in science overthrowing some old notion is an attack on religion, will be able to point to him as a man consistent and diligent in both spheres of life, to whom it never occurred that there was any conflict to be adjusted.

The history of learning is full of examples of men who have risen to eminence from the most incongruous surroundings, without adventitious aids, but solely by the force of their own impulses. Professor Gray affords another. His advantages were of the most limited character. His working life began with tending his father's tan-bark mill, while he was distinguished as being the champion speller of his school district. Two years at a grammar-school, one year at the academy, and a medical course, constituted his entire formal education. He had no classical training, no scientific instruction further than was subsidiary to the medical studies of which he made no use. But he became one of the leading scientific men of his age, and, as Professor Dana remarks, "eminent for his graceful and vigorous English, the breadth of his knowledge, his classical taste, and the acuteness of his logical perceptions." An article in the "Edinburgh Encyclopædia" directed his attention to botany. He procured Professor Eaton's text-book, which was perhaps one of the best on the old system—but how different from the works of the series with which he made the science luminous!—and began his brilliant scientific career with the analysis of *Claytonia Caroliniana*. He must have been proficient in his studies, for we find him before the close of his medical course taking the place of the professors in lectures at Albany and Hamilton College. Then he became a regular teacher himself; was associated with Dr. Torrey in his researches; published his own investigations of the sedges and of the plants of northern and western New York; and prepared his first text-book, "The Elements," in 1836, a book in which, according to Professor Dana, the subjects of vegetable structure, physiology, and classification were presented in a masterly manner, and which "showed his customary independence of judgment and clear head in various criticisms and suggestions."

The name of Professor Gray is intimately associated with Darwin's in the history of the theory of the origin of species. The series of letters from Darwin to Gray, contained in the recently published "Life and Letters" of Darwin and beginning on page 420 of the first volume, attest the respect Darwin had for his knowledge, the confidence which he reposed in his opinions, and the hearty fellowship that existed between them. Gray, Lyell, and Hooker were the three whose approval

of his theory Darwin most desired to enjoy, and were the three to whom he earliest and most fully confided his views. Yet Gray and he did not agree entirely in their acceptance of the theory. While Darwin gave the predominant place to the environment in determining variation, Gray thought that the process worked more from within and was at most modified or limited by the external conditions. Darwin had extreme difficulty in accepting the conception of a Supreme Intelligence ordaining and controlling the process of evolution; Gray held to a complete harmony between the working of a Supreme Power and of evolution, and declared that "natural law is the human conception of continued and orderly divine action."

Professor Gray's "Statistics of the Flora of the United States" and his observations on the plants of Japan have an important bearing upon the theory of the origin of animal and vegetable life in the polar regions and their distribution thence down the continents, which is now advocated by biologists and paleontologists of high standing.

Professor Gray has not been conspicuous as a man of letters, but we may justly claim for his botanical works a place in literature as such. He contributed to the "American Journal of Science" biographical notices of deceased botanists and reviews of botanical work in which his accurate criticisms were tempered by a uniform kindliness of spirit, and he made considerable contributions to the "North American Review," "The Nation," and the "Atlantic Monthly." A volume of selections from these contributions, with a chapter on "Evolutionary Teleology," was published in 1876, under the title of "Darwiniana."

Professor Gray's personal character was admirably characterized by Darwin, who concluded, before he had even seen him, from reading some of his letters to Hooker, that he must be a man with something very lovable about him. A friend, paying a tribute to him in the London "Spectator," speaks warmly of his "singularly sweet and beautiful nature," and of "the freshness and brightness that recalled nothing but youth," of which not years nor learning, nor incessant studies, nor even the classification of the American *Compositæ*, could deprive him; and added that Darwin's son, to whom he sent a parcel of stamps to cheer his sickbed, "was not the only English child who received a like present from the same giver."

What the world of science thought of Asa Gray is attested by the honors which its schools and its societies conferred upon him, and by the respect, as to one having authority, in which he is invariably spoken of by its most distinguished writers. American feeling was reflected in the token which was presented to him a little more than two years ago by one hundred and eighty-five botanists, all in a sense his students, with Mr. Lowell's quatrain.

Professor Gray was taken away from the midst of his work. He had just completed a review of Darwin's "Life and Letters," had not quite finished the revision of his "Vitaceæ," and was busy with his "Necrology" for the "Journal of Science," when he was stricken.

HOW IT WORKS.

One of the recognized evils attendant on the public-school system of this country is the insecurity of the tenure by which teachers hold their situations. So manifest an evil has this been that in certain States it has been proposed to remedy it by legislation. But, supposing the evil entirely removed, what would the result be? We can perhaps judge by what one of the best conducted of our educational journals says is the case in the great State of Illinois. We are not aware at this mo-

ment what is the law in that State respecting the appointment of teachers, but from what our contemporary, the "Illinois School Journal," says, some teachers, and other school officials as well, have only too strong a hold on the positions they fill. "One of these," —we quote from the "Journal"—said the other day: "Why should I read books or bother my head to study about teaching? What will it profit *me*? My place is secure. I have as many friends as my principal or superintendent has. Let him try to remove me if he dare." "There is much of this spirit," continues the "Journal," "in the schools, especially in the large cities. It is not among the teachers alone. It is among principals and superintendents as well. These people long since ceased to study and grow." So, here is the dilemma: If the teacher has no security of tenure, he has no encouragement to throw himself heartily and earnestly into his work. If, on the other hand, he has, either through legal enactments or through his political associations, a firm hold upon his place, he is in danger of lapsing into the condition of mind and general disposition above described. It may be said that security of tenure, in the sense understood by the teachers, would not mean exemption from proper official supervision and authority, or an absolute right to employment in spite of proved disqualification; but, admitting this, it is still clear that, under such a system, the difficulty in the way of getting rid of indifferent or even of seriously deficient teachers would be very great. The "Illinois School Journal" says distinctly, and, as we think, truly, that we shall only be able to improve the schools when we have learned how to improve the teachers. What kind of material is offered, under the present system, for the teaching body we learn from a further article in the same periodical by a gentleman who states that he has been for years a member of the State Board of Examiners. "Experience," says this authority, "shows that many candidates fail on common English branches, particularly arithmetic and reading. . . . The papers show such deficiency in form as to indicate that teachers are extremely careless in this respect. The arrangement of work, the carelessness in regard to paragraphing, and even the use of capital letters, shows gross neglect of the proper usages of written language. Some show that they learned their spelling late in life, and that, when hurried, they revert to some juvenile form. . . . The worst and least excusable mistakes were in the definition of common words. Defining a noun by a verb, a verb by an adjective, an adjective by an adverb, was altogether too common. The derivation of words was hopelessly, painfully ridiculous." The examination papers in connection with which all this occurred are appended to the article from which we quote; and their extreme simplicity makes the statements of the article only the more surprising. The history, geography, arithmetic, and etymology are well within the compass of any fairly-taught lad of twelve or thirteen. Samples of the answers given are also furnished; and all we can say is that they well deserve a place beside Mark Twain's famous collection. One candidate who, in the paper on pedagogics, was asked to "define the terms *subjective* and *objective* as used in mental philosophy," answered that "we treat a topic subjectively when we take what we know of a subject and explain, without having any special object in view." Evidently, all that this individual knew of his "topic" would not have afforded a basis for much explanation, with or without an object in view. A very noticeable feature is the thorough dishonesty of many of the answers. Being asked to give the etymology of the word "urbane," one candidate said it was from *ur*, outside, and *bane*, city; another that it was from *ur*, a city,

and *bane*, badly. Each of these would-be teachers and guides of the young knew that he, or she, was "guessing" in the most shameless manner—that is to say, practicing one of the very vices to which school-children are most prone, and which it is the duty of their teachers most earnestly to reprehend and repress.

Of course, it will be said that the worst cases of ignorance and incompetency were culled out by the examination; but the language of the article referred to indicates clearly enough that the general average of the candidates was low; and, if so, it may be assumed that many very poorly qualified persons crept through and got their certificates. And this is how the system is working to-day, when so many improvements on the old order of things are supposed to have been made. We greatly fear that, between the politics that make good teachers insecure, and bad ones secure, in their positions, and examinations that are largely farcical in their character, the interests of the rising generation are not being very intelligently or conscientiously studied. Good men and women no doubt there are, and many of them, engaged in the State schools; but these, we fear, can not avail to save the whole system from gravitating to that low point of efficiency which marks governmental action in all matters which lie outside the necessary and natural functions of government.

LITERARY NOTICES.

ANIMAL MAGNETISM. By ALFRED BINET and CHARLES FÉRÉ. "International Scientific Series," Vol. LIX. New York: D. Appleton & Co. Pp. 378. Price, $1.50.

MESMERISM, hypnotism, or animal magnetism, has had varied fortunes. Forced into the field of scientific discussion about a century ago by the elaborate pretensions of Mesmer, it has been alternately cultivated, condemned, and neglected by scientific men, and has been fostered chiefly by quacks as a ready means of exciting the admiration and opening the purses of the curious. At present the subject is one of growing interest. It is receiving respectful attention generally in the scientific world, and is being studied in a conservative manner by certain specialists. The exceptional advantages for the study of nervous phenomena afforded by the medical practice in the Salpêtrière, the great hospital for women in Paris, have been employed with important results. The observations and experiments recorded in the present volume have been made in that hospital, and in accordance with the method inaugurated by M. Charcot, the chief of the school of the Salpêtrière. The book aims only to give an account of these researches, and, notwithstanding their number and variety, the authors do not feel that enough material has yet been collected to base general conclusions on. In the first three chapters a history of the subject is given, after which the investigations of Charcot and his pupils are taken up. These observers recognize three chief states of hypnotism: catalepsy, lethargy, and artificial somnambulism, the modes of producing which, together with their symptoms, are described. Then follows a study of suggestion, or the power of an experimenter to make a hypnotized subject speak, act, think, and feel as it pleases the former to dictate. Hallucinations affecting each of the senses may be impressed upon the subject, and even unilateral hallucinations may be produced. Suggestions of acts to be performed at once or at some future time may be given, and, though the acts may be repugnant to the subject, he can not refrain from performing them. Insensibility to touch, and even to the pain of a surgical operation, may be produced by suggestion, and motor paralysis as well. All these phases of the subject are illustrated by a great variety of cases. Attention is called in the two closing chapters to certain applications of hypnotism. First, hypnotism may become a valuable curative agent for real diseases caused by the imagination, which appear in persons having a certain weakness of the nervous system. This fact throws light on the subject of miraculous cures and mental healing, which has recently attracted so much attention. Second, it

may be employed for certain cases in education. Finally, the accomplishing of criminal acts upon or by means of a hypnotized person, and the obtaining of true or false testimony by means of hypnotism, constitute a branch of the subject which society may soon have to take serious account of. Although dealing with phenomena that border on the marvelous, this book is not at all sensational, and the reader may rest assured that it will give him a sound scientific view of the interesting field which it covers.

AN INQUIRY INTO SOCIALISM. By THOMAS KIRKUP. London and New York: Longmans, Green & Co. Pp. 188. Price, $1.50.

AN intelligent exposition of the principles and aims of socialism from one of its supporters is certainly welcome at the present time, when public attention is directed so universally toward important socialistic movements. This volume presents the author's views as to the evils of the existing industrial system, his interpretation of the essential ideas of socialism, and a review of the prospects of the latter. It is a very readable work, is well written, and gives in small compass a great deal of useful information and valuable discussion upon all the topics above mentioned. It is of similar character to Professor Graham's "Social Problems," though going beyond the latter in its belief in the efficacy of socialism as a system to remedy the ills afflicting society.

We think the account of the evils of the present industrial system is the best part of the book. We are quite unable to agree with the author in his evidently sincere conviction that socialism will furnish any permanent remedy for those ills, and do not think he demonstrates how it can. This, however, is a matter of difference in fundamental principles. But the main criticism we pass upon the work before us is that it stretches the term socialism so far as to embrace almost everything that makes for the improvement of human life and conditions. Socialism is justice, altruism, practical Christianity, progress, social evolution; and these in turn are socialism. We are unable to allow the propriety of thus connecting the latter term with all these beneficent things. As most people suppose, socialism is in principle the accomplishment by state action of co-operative production and the equalization of distribution, using the state for positive amelioration, instead of confining its offices to guaranteeing liberty and security. We should not let our enthusiasm for any *ism* run away with our powers of observation; and certainly these, if properly exercised, would show us that it is highly premature at any rate to cover by the common designations *socialism* and *socialistic* all the ideals of a better social order, and all the most promising methods for attaining it. But this is really what the author seems to do; he makes a cult, and worships blindly an idealized deity, without taking sufficient pains to find out the real character of his idol.

THE VENTILATION AND WARMING OF SCHOOL-BUILDINGS. By GILBERT B. MORRISON. "International Education Series," Vol. IV. New York: D. Appleton & Co. Pp. 173. Price, 75 cents.

THE author of this treatise presents both the theoretical and the practical sides of his subject, and the principles which he sets forth are applicable to all other buildings as well as to school-houses. He describes first the necessity for ventilation, and the methods of detecting impurities in air, and then discusses various modes of natural and artificial ventilation. His chapter on ventilation by windows will prove useful in many cases where no better means for the purpose exist. Another chapter gives careful estimates of the cost of ventilating. The subject of warming is treated in a similar manner, and the final chapter of the volume is devoted to the ideal plan for warming and ventilating combined, which has grown out of the author's study of these allied subjects. An appendix contains various thermal formulas and notes in regard to certain mechanical ventilating appliances. The volume is illustrated.

THE ANNUAL REPORT OF THE CHIEF SIGNAL-OFFICER FOR 1886. Washington: War Department. Pp. 500.

THIS volume contains the usual statistics in regard to military signaling and the Government Weather Bureau. The proportion of weather indications verified during the year was 78·48 per cent.

DRESS. A Monthly Magazine, conducted by Mrs. ANNIE JENNESS MILLER. New York: The Gallison & Hobron Company. Price, $1.50 a year.

THIS periodical, whose first number appeared in May, 1887, is devoted primarily to "the practical and the beautiful in women's and children's clothing," but gives attention also to physical culture and kindred subjects, while fiction and poetry are not excluded from its pages. "The Popular Science Monthly" has at various times called attention to the unhealthful features of the current mode of women's dress, and indicated the principles of a correct system; hence we heartily indorse the effort of "Dress" to secure the general adoption of a style of clothing for women which does not cause torture and disease of the body and distraction of the mind. In order to find acceptance, such an improved system must fully equal in beauty and neatness the fashionable costumes of the day. Mrs. Miller is giving due attention to this condition; her designs for suits and toilets seem attractive enough to insure for her system the success which its hygienic character deserves. The under-garments which she advocates are of the union pattern, and consist of a jersey-fitting garment next the skin, over which is worn a "chemilette," and over this "leglettes," either plain or full, which take the place of petticoats. Outside of these comes the gown-form, a waist and skirt combined, forming a foundation upon which dresses of various styles of drapery and trimming can be arranged. Corsets are discarded, though, for stout women, with flabby muscles, a "bosom support" is deemed allowable. The magazine is edited with taste and judgment, and its illustrations and mechanical work are attractive.

THE ART OF PROJECTING. By Professor A. E. DOLBEAR. Second edition. Illustrated. Boston: Lee & Shepard. Pp. 178. Price, $1.

PROFESSOR DOLBEAR has revised and made additions to this work in the edition just published. The chief parts of the new matter relate to the use of electric lamps and lights for projection purposes, and to the production and phenomena of vortex rings.

RICHARD LEPSIUS: A Biography. By GEORG EBERS. New York: W. S. Gottsberger. Pp. 347. Price, $1.25.

THIS volume gives quite a full account of the university studies of Lepsius, and of the state of Egyptology when he devoted himself to it immediately after the death of Champollion. Then follow descriptions of his work in the collections of Egyptian antiquities in Paris, Italy, Holland, and England, and of the Prussian expedition to Egypt under his direction. Succeeding chapters present Lepsius as "the master-workman" and as a man, and the home of Lepsius. A list of his works is appended, and a portrait, with autograph, forms the frontispiece.

ON TEACHING ENGLISH, WITH DETAILED EXAMPLES, AND AN INQUIRY INTO THE DEFINITION OF POETRY. By ALEXANDER BAIN. New York: D. Appleton & Company. Pp. 256. $1.25.

THIS volume includes a review of the prevailing opinions as to the proper mode of teaching English, with a critical estimate of their respective merits, the handling of which is of necessity controversial; a brief sketch of the rhetorical method, followed by a series of select lessons on the leading qualities of style, intellectual and emotional; and an inquiry into the definition of poetry, which is intended to fall in with the treatment of rhetorical principles, both in theory and in practice. In the first part, the author disputes the theory that Saxon words should be preferred to classical in writing, or that they are preferred in actual speech; discusses the order of words; and considers the art of weaving the various threads which enter into the composition of the narrative in such a way as best to preserve the harmony and balance of all the parts. An estimate is given of the value of the older writers, and their defects as standards in composition; the advantages and disadvantages of essay-writing, paraphrasing, and converting poetry into prose, as exercises, are measured; and the methods exemplified in Bacon's essays are analyzed as showing "how not to do it." A large proportion of the space is given to the "select lessons" illustrating the intellectual and emotional qualities of style, in which many complete compositions from the standards of English

literature are dissected, analyzed, and criticised in detail, with especial reference to those characteristics. Poetry being regarded as a fine art, the source of its definition is sought in the sphere of the human emotions. In respect of matter, it is contrasted with science, oratory, morality, and religion; in respect to literary form, it is distinguished from history, narrative, description, and exposition, all of which, however, have their poetical aspects. And the pure romance, or novel, is considered "a species under the genus poetry, which must be so far widened as to include it."

BIOGRAPHIES OF WORDS; AND THE HOME OF THE ARYAS. By F. MAX MÜLLER. London and New York: Longmans, Green & Co. Pp. 278.

ADMITTING that language and thought are inseparable, as the author has labored to show, it follows that all thoughts which have ever passed through the mind of men must have found their first embodiment and their permanent embalmment in words. If, then, we want to study the history of the human mind in its earliest phases, where, Professor Müller asks, can we hope to find more authentic, more accurate, more complete documents than in the annals of language? "Every word, therefore, has a story to tell us, if we can only break the spell and make it speak out once more. It is known that every word, if we can analyze it at all, is found to be derived from a root. It is equally well known that every root is predicative, that it predicates something of something, and that what it thus predicates is in reality an abstract or general concept. This applies to all languages, even to those of so-called savages, whenever they have been subjected to a really scholar-like analysis. . . . Every language, if properly summoned, will reveal to us the mind of the artist who framed it, from its earliest awakening to its latest dreams." In the light of these views, the history and fortunes of a certain number of words and expressions in common language are taken up and traced back through the various changes which the forms have undergone, as far back as possible toward their original Aryan roots. The chapters on "The Home of the Aryas" and "The Earliest Aryan Civilization" are devoted to the vindication of the theory that the original seat was in central Asia, as against the newly-proposed view that it was in northern Europe. These chapters are followed by a list of words in the seven principal languages of Aryan descent, which is intended to illustrate the argument. The appendices contain letters on the Aryan fauna and flora, the original home of jade, the original home of the soma, "philosophy *versus* ethnology," and a discussion whether copper or iron was the third metal. The author, with his warm enthusiasm, has a rare way of making the dry and abstruse theme on which he is engaged, despite the terrible-looking words and roots with which he illustrates his points, singularly attractive. We are pleased to see that he regards the labors of our Americans, Brinton and Hale, with others, as "every whit as important as the labors of Grimm, and Kuhn, and Pott."

THE "HOW I WAS EDUCATED" PAPERS. New York: D. Appleton & Co. Pp. 126. Price, 30 cents.

THE pamphlet having the above title is a collection of autobiographical articles by Rev. E. E. Hale, T. W. Higginson, W. T. Harris, and Presidents or ex-Presidents of Columbia College, the Chautauqua University, Dartmouth, Vassar, Yale, Brown, Michigan, and Cornell, which first appeared in "The Forum." As Mr. Hale wittily describes the articles, "The editor of 'The Forum' has thought that a series of papers, in which different people shall describe the methods of their school-education, may be at least amusing, and perhaps profitable, if only by way of caution. He has, therefore, induced a good many men to pose on his platform as 'awful warnings,' and, as it happens in the story of the Indian march, he selects a little elephant to lead the risky way down into the river."

TREES OF READING, MASSACHUSETTS. Part I. By F. H. GILSON. Reading: The Author. Price, $1.50.

MR. GILSON has embodied a very attractive idea in a most tasteful manner. The pamphlet consists of heliotype views of five fine old trees — elm, sassafras, oak, and birch — standing in the town, near Boston, where the author resides, with a page of description and history of each one, and an

introduction. The sheets are printed on one side only, with a liberal margin, and are not stitched. There is scarcely a village in the early-settled part of the country but has such trees, forming characteristic features of its landscape, and serving as memorials of interesting local events. Mr. Gilson photographed these trees, and collected the information about them in the first place for his own gratification; but, finding others interested, he has published a first installment of his material, and, if enough copies of this part are sold to pay expenses, other parts will follow.

EXACT PHONOGRAPHY: A SYSTEM WITH CONNECTIBLE STROKE VOWEL-SIGNS. By GEORGE R. BISHOP. New York: the Author (at the New York Stock Exchange). Pp. 244. Price, $3.

THE question of providing stroke vowel-signs, which could be written in with the consonants without lifting the pen from the paper, has engaged the attention of many phonographers, but the results have so far not been encouraging, and a conviction has arisen that, however desirable this feature might be, it was impracticable in a working short-hand. Mr. Bishop has, nevertheless, undertaken the task, and has made a serious, persistent, and ingenious attempt to conquer the difficulty. The measure of his success can not be accurately given; time and practical use will be necessary to settle that; but he may fairly claim now to have shown that the obstacle was not unsurmountable. That Mr. Bishop's work should attain the ultimate solution of the problem is not to be expected; but it is certainly an approximation, and probably furnishes the basis on which the perfected scheme will rest. The greatest gain to be derived from the stroke vowel-signs is in increased immediate legibility—a very important matter. This is given partly by increasing the list of alternate forms by means of which a somewhat arbitrary distinction may be effected between words that otherwise would require to be written alike and distinguished by the context, but chiefly by the ability to include a vowel which may be perfectly decisive of the word intended. The writer of the new system will frequently have the opportunity to choose whether he will sacrifice consonants or vowels; while heretofore no choice was left to him, provision having been made simply to throw out the vowels in all cases, to meet the requirement of speed. A mere consonant outline is frequently entirely devoid of suggestiveness, although perfectly unmistakable when the word to which it belongs is found. The lack of convenient vowel-signs also has probably helped to discourage the adoption of phonography as a medium of correspondence; the labor of inserting the vowels being irksome to the writer, and that imposed by their omission being still more irksome to the reader. Mr. Bishop's book is certainly worthy of attention from all who desire to become or to remain professional short-hand writers.

THE JOURNAL OF MORPHOLOGY. Vol. I, No. 1. September, 1887. Edited by C. O. WHITMAN, with the co-operation of EDWARD PHELPS ALLIS, Jr. Boston: Ginn & Co. Pp. 226.

THE establishment of a new scientific journal is a source of gratification to all who are sufficiently acquainted with the history of research in pure science to realize the assistance, both to further acquisitions and to practical applications of knowledge, which is afforded by making known the results of investigations. Accounts of the work of American zoölogists, the editor of the "Journal" remarks, are to be sought "in the various publications of the Smithsonian Institution, in voluminous reports of government commissions, in the memoirs and proceedings of societies and academies, in the bulletins and memoirs of a few universities, and in numerous periodicals devoted to the natural sciences." As no branch of science can make much progress until the care of specialists succeeds its fitful cultivation by investigators largely occupied with other subjects, so its literature is much less accessible and effective when scattered through a variety of scientific miscellanies than when concentrated in a special organ. The first number of "The Journal of Morphology" gives evidence that the previous lack of an American zoölogical journal, ably edited, and printed and illustrated in a liberal style, has now been well supplied. The number comprises the following seven papers: "Sphyranura Osleri, a Contribution to American Helmin-

thology," by Professor R. Ramsay Wright and A. B. Macallum; "The Development of the Compound Eyes of Crangon," by Dr. J. S. Kingsley; "Eyes of Mollusks and Arthropods," by Dr. William Patten; "On the Phylogenetic Arrangement of Sauropsida," by Dr. G. Baur; "A Contribution to the History of the Germ-layers in Clepsine," by C. O. Whitman; "The Germ-bands of Lumbricus," by Professor E. B. Wilson; and "Studies on the Eyes of Arthropods," by Dr. William Patten, all of which, except that on arrangement of Sauropsida, are accompanied by lithographic plates. The "Journal" is to be devoted chiefly to embryological, anatomical, and histological subjects, and will be practically limited to *animal* morphology. Each number will contain from 150 to 200 or more pages, and eight or ten lithographic plates. There will be no stated times of publication, but numbers will appear when the material on hand makes it desirable. This undertaking deserves that every American zoölogist should do his share toward insuring for it a continuance of life and usefulness.

ASTRONOMY FOR AMATEURS. Edited by JOHN A. WESTWOOD OLIVER. Illustrated. London and New York: Longmans, Green & Co. Pp. 316. Price, $2.25.

THIS manual has a different field from that of books which aim merely to point out the beauties of the firmament. "Its pages are intended to afford the amateur astronomer, possessed of limited instrumental means, but yet anxious to devote his labors to the furtherance of astronomical science, such hints and suggestions as will help him to direct his efforts into the channels which experience has indicated as best fitted to his qualifications and equipment." The editor has had the assistance of eminent specialists in various departments of astronomy.

ORMSBY MACKNIGHT MITCHEL. By his Son, F. A. MITCHEL. Boston: Houghton, Mifflin & Co. Price, $2.

THIS biography is a vivid panorama of the career of an enthusiastic astronomer and faithful general. The history and character of the subject have been presented, so far as possible, in the words of his diary and letters. The account of the founding of the Cincinnati Observatory, and of Professor Mitchel's visit to Europe to procure instruments, is almost entirely derived from his papers, but there was not sufficient material available for a complete life-record of this sort. The space devoted to his service in the civil war, limited by his death to fourteen months, about equals that occupied with his early life and his scientific work.

NATURAL RESOURCES OF THE UNITED STATES. By JACOB HARRIS PATTON, M. A., Ph. D. New York: D. Appleton & Co. Pp. 523. Price, $3.

THIS comprehensive work presents in a single volume as full an account as the general reader will require of the many and varied natural products which are yielded by land and water in the United States. The first hundred pages are devoted to the coal-fields from Texas to Alaska, giving a brief section to each locality or variety, and including the leading facts of the geology of the carboniferous deposits. The coal-fields of Canada and Europe are also briefly mentioned. Petroleum and natural gas come next in order, and then iron-ores are treated of in the same manner as coal. The comparatively short chapters on gold and silver include accounts of the original discoveries in some of the most famous mining regions of the country. The other useful metals receive due attention. The chief deposits of precious stones, clays, building-stones, marbles, and abrasive materials are named, while such minerals as graphite, salt, sulphur, borax, mica, and asbestus are not forgotten. Among mineral resources medicinal waters of course have a place, and the account of these naturally leads up to a chapter on health-resorts. The consideration of the vegetable resources of the country is introduced by a description of its climate and rainfall. The fisheries, the fur-seal, and wild game are the chief resources belonging to the animal kingdom, while the people of the United States have two other great natural resources in water-power and unoccupied homestead lands. For the American or foreigner whose occupation or whose desire to be well informed gives him an interest in this class of facts relating to the United States, the volume is one that can be read with pleasure, and that will be frequently referred to. It should be in the

library of every American consul, and the purchase of a sufficient number of copies to supply those officers would be a very proper transaction on the part of the State Department.

THE NEW ASTRONOMY. By SAMUEL PIERPONT LANGLEY, Ph. D., LL. D. Illustrated. Boston: Ticknor & Co. Pp. 260. Price, $5.

READERS of the "Century" magazine will give this handsome volume a cordial welcome without the formality of an introduction, for the chapters of which it is composed have appeared from time to time as illustrated articles in that periodical. Those who are not already acquainted with the fascinating style in which the author depicts the wonders of modern astronomy will derive even more pleasure from the book. In explanation of his title, "The New Astronomy," Professor Langley says that until very lately the prime object of astronomy has been "to say *where* any heavenly body is, and not *what* it is," but that, within a comparatively few years, a new branch of the science has arisen, "which studies sun, moon, and stars for what they are in themselves and in relation to ourselves." This branch of astronomy, sometimes called celestial physics, deals with the constitution, condition, and configuration of the sun, moon, and planets; of meteors, comets, and stars. The view of this field which Professor Langley gives is general rather than detailed, for his book is not addressed to the professional reader, but is intended to solicit for the "new" astronomy the interest and support of the educated public. It is admirably adapted to produce this effect. Its descriptions are picturesque without bending the lines of fact, and its language is vivid without being inaccurate. Ninety-three figures, many of them of full-page size, embellish the volume, and the paper, printing, and design of the cover are of the handsomest. Four of the eight chapters of the work are devoted to the sun. The author takes up first the spots on the sun, those immense blotches sometimes exceeding in extent the whole surface of our globe, and tells what is known as to their cause. He regards as not proved the idea that sun-spots have an influence on the weather, thereby affecting harvests on the earth, but a connection between the spots and terrestrial magnetic disturbances he deems sufficiently established. The sun's corona, as seen in eclipses, and the solar prominences are next described. In the two chapters on the sun's energy some idea of the quantity of heat radiated from the sun is given, and the question of how the solar fire is fed is discussed. The absolute dependence of all activity and life on earth upon the supply of heat received from the sun is pointed out, and the idea of a greater need for utilizing this heat in the future by means of solar engines is suggested. Of the planets, Saturn, Jupiter, and Mars are selected for special attention. The moon is described with gratifying fullness, and an excellent idea of its surface is given by the reproductions of lunar photographs, and of photographs of volcanic formations on the earth, and of other wrinkled and cracked surfaces, which are inserted for comparison. The phenomena of meteors and comets are presented in the same enthusiastic style which characterizes the rest of the book. The concluding chapter embodies some of the results of the application of the spectroscope to stellar research. The volume is an admirable one for the library of the cultured general reader, for it gives information without an array of figures which are as wearying to everybody but specialists as they are interesting to that class; it presents conceptions of the vast magnitudes, distances, and forces of the visible universe in the form in which they can be best grasped; and while it inspires a respect for the great results which have been accomplished by the genius and industry of modern astronomers, it also conveys a sense of the boundless regions of space beyond the range of their instruments, for the present unknown to earthly intelligence, and, perhaps, forever unknowable.

HALF-HOURS WITH THE STARS. By RICHARD A. PROCTOR. New York: G. P. Putnam's Sons. Pp. 39. Price, $2.

THE above-named edition of Professor Proctor's "Half-Hours" appears with maps and text specially prepared for American students. It is an atlas of twelve maps, showing the position of the principal star-groups throughout the year, with an explanation of each map, and an introduction.

THE EARTH IN SPACE. By EDWARD P. JACKSON. Boston: D. C. Heath & Co. Pp. 73. Price, 35 cents.

THIS convenient and copiously illustrated little manual comprises the facts in regard to the earth as a planet which are commonly included in text-books of geography, under the heading mathematical or astronomical geography, together with other matter in this most practical department of astronomy. It is designed for schools in which time can not be spared for a general course in astronomy.

MANAGEMENT OF ACCUMULATORS, AND PRIVATE ELECTRIC LIGHT INSTALLATIONS. By Sir DAVID SALOMONS. Third edition, revised and enlarged. New York: D. Van Nostrand. Pp. 150.

THIS little book is the result of the author's long experience with electric lighting, which was preceded by the use of a private gas-making plant on his own estate. He has used secondary batteries since they first became practicable, sparing no expense to obtain satisfactory results, and feels confident that his directions will make the seeking of professional advice rarely necessary.

PUBLICATIONS RECEIVED.

Alden, John B., New York. Bits of Knowledge taken from Alden's Manifold Cyclopædia. 4 cents.

Ali Aziz Effendi. The Story of Jewad. Translated by E. J. W. Gibb from the Turkish. New York: W. S. Gottsberger. Pp. 241.

Ames, Julia A. Platform Voices (Temperance Recitations). Chicago: Woman's Temperance Publishing Association. Pp. 144. 25 cents.

Anderson, Professor W. E., Milwaukee. The Physical Side of Education. Pp. 18.

Art, the, of Investing. By a New York Broker. New York: D. Appleton & Co. Pp. 198.

Battershall, Jesse P. Food Adulteration and its Detection. New York: E. and F. N. Spon. Pp. 328, with Plates.

Blackbird, A. J. History of the Ottawa and Chippewa Indians of Michigan, and Grammar of their Language. Harbor Springs, Emmet County, Mich. Pp. 128. $1.

Bloxam, Charles L. Chemistry, Inorganic and Organic, with Experiments. Sixth edition. Philadelphia: P. Blakiston, Son & Co. Pp. 788. $4.50.

Claypole, E. W. The Lake Age in Ohio. Edinburgh. For sale by Robert Clarke & Co., Cincinnati. Pp. 42. 75 cents.

Commissioner of Education of the United States. Report for 1885-'86. Washington: Government Printing-Office. Pp. 792.

"Congress. A Monthly Journal of the Arts of Civilization." Vol. I, No. 1. Washington: Congress Publishing Company. Pp. 20. 10 cents. $1 a year.

Cust, Lady. The Invalid's Own Book. A Collection of Receipts. New York: W. S. Gottsberger. Pp. 144.

Cornell University, Ithaca, N. Y. Register for 1887-'88. Pp. 216.

Davis, George, Minneapolis, Minn. A New Theory of the Origin of Life and Species and their Distribution. Pp. 52. 15 cents.

De Camp, W. M., Editor and Proprietor. "American Liberty," a Quarterly Magazine. January, 1888. Pp. 8. 10 cents a year.

Denison, T. S. The Man Behind. A Novel. Chicago. Pp. 311. $1.50.

Galdós, B. Perez. Leon Roch. Translated by Clara Bell. New York: W. S. Gottsberger. Two vols. Pp. 287 and 315.

Griswold, W. M., Bangor, Me. Annual Index to Periodicals for 1887.

Guthrie, O. Memoirs of Dr. Samuel Guthrie and the History of the Discovery of Chloroform, Chicago. Pp. 85.

Heilprin, Angelo. Geological Evidences of Evolution. Philadelphia: Published by the Author. Pp. 99.

Hodges, N. C. "The Puzzler." Vol. I, No. 1. February, 1888. Monthly. Seven Plates. 10 cents. $1.25 a year. Pp. 28.

Holcombe, William H. Condensed Thoughts on Christian Science. Chicago. Purdy Publishing Company. Pp. 58.

Hudson, Mrs. Mary W. Esther the Gentile. Topeka, Kan.: George W. Crane & Co. Pp. 167, $1.

Imperial University of Japan. Calendar for 1887-'88. Tokio. Pp. 194.

Jacques, William W. An Empirical Rule for constructing Telephone Circuits. Pp. 12.

James, W. P. and J. F., Oxford, O. On the Monticuliporoid Corals of the Cincinnati Group, etc. Pp. 28.

Lake Forest University. Catalogue, 1887-'88. Pp. 128. Addresses delivered at the Inauguration of Rev. William C. Roberts, President. Pp. 50.

Lithographic Publishing Company, New York. Photographers' Directory, etc. Pp. 207. $3.

Long, J. H. Slips of Tongue and Pen. New York: D. Appleton & Co. Pp. 101.

McLaughlin, J. W., Austin, Tex. The Nature of Contagion. Pp. 8.

Maynard, G. W., and Kunhardt, W. B. On the Dressing of Non-Bessemer Ores. Pp. 17.

Morehead, Mrs. L. M. A Few Incidents in the Life of Professor James P. Espy. Cincinnati: Robert Clarke & Co. Pp. 22.

Newman, Robert, M. D., New York. The Galvano-Cautery Sound, and its Application. Pp 58.

New York Academy of Sciences. Transactions, 1886-'87. Heman Leroy Fairchild, Secretary. Pp 187.

New York Agricultural Experiment Station, Geneva. Report for 1887. Pp. 462.

Osservatorio Nacional Argentino (Argentine National Observatory), Resultados (Results). Vol. II. Juan M. Thome, Director. Buenos Ayres. Pp. 261.

Peabody, Andrew P. Harvard Reminiscences. Boston: Ticknor & Co. Pp. 216. $1.25.

Peck, John. Miracles and Miracle-Workers. Pp. 34. Christian Absurdities. Pp. 8. New York: Truth-Seeker Company.

Proudhon, P. J. System of Economic Contradictions; or, the Philosophy of Misery. Vol. I. Translated and published by Benjamin R. Tucker, Boston. Pp. 469. $3.50.

Richter, Professor Victor von. Text-Book of Inorganic Chemistry. Authorized Translation, by Edgar F. Smith. Philadelphia: P. Blakiston, Son & Co. Pp. 428. $2.

Rensselaer Polytechnic Institute Register for 1887. Pp. 87.

Seidel, Robert. Industrial Instruction: a Pedagogic and Social Necessity. Translated by Mar-

garet K. Smith. Boston: D. C. Heath & Co. Pp. 170. 80 cents.

Stewart, Balfour, and Gee, W. W. Haldane. Practical Physics. Vol. I. Electricity and Magnetism. London and New York: Macmillan & Co. Pp. 221. 60 cents.

Swedenborg, Emanuel. The Soul; or, Rational Psychology. Translated and edited by Frank Sewall. New York: New Church Board of Publication. Pp. 388. $3.

Theosophical Publication Society. Theosophy and the Critics. London: George Redney. Pp. 18.

Todd, David P. Preliminary Report (unofficial) of the Total Solar Eclipse of 1887. Amherst (Mass.) Observatory. Pp. 16.

"The Truth-Seeker Annual and Freethinker's Almanac, 1888." New York: Truth-Seeker Office. Pp. 118. 25 cents.

Tuckerman, Frederick. M. D., Amherst, Mass. Note on the Papillæ Foliatæ and other Taste Areas of the Pig. Pp. 5. The Tongue and Gustatory Organs of Fiber Zibethecus. Pp. 7, with Plates.

Tylor, E. B. Anthropology. (International Scientific Series.) New York: D. Appleton & Co. Pp. 448.

Van Dyke, Henry, D. D. The National Sin of Literary Piracy. New York: Charles Scribner's Sons. Pp. 23. 5 cents.

Varona, Enrique José. Conferencias Filosóficas (Philosophical Lectures). Second Series. Psicología (Psychology). Havana. Pp. 474.

Von Rosenberg, Leo. The Vosburg Tunnel. A Description of its Construction. 35 Broadway, New York. Pp. 56, with Plates.

Woodward, C. M. The Manual Training School: its Aims, Methods, and Results, etc. Boston: D. C. Heath & Co. Pp. 374. $2.

POPULAR MISCELLANY.

Out-Door Play for School-Girls.—Professor W. E. Anderson, in a paper on "The Physical Side of Education," forming part of the Wisconsin State Board of Health Report for 1887, makes a plea for the indulgence of school-girls in play. He says: "Our school-girls lead a life without play, in the real meaning of the term. Muscular exertion is confined entirely to locomotion, or to movements requiring exercise of the lower part of the body. The restrictions of dress are such that movement above the waist is out of the question. The vital organs are restricted by dress, fashion, and occupations supposed to be suitable to the sex. Notice the difference between the movements of boys and girls of the same age, and attending the same class. While the boys can engage in every species of activity, and practice some sports perhaps too grotesque to be permissible for the opposite sex, the girls of sixteen are satisfied with a stately walk around the block, two under one shawl, conning the next lesson to be heard after school is called. All this is certainly a perversion of what Nature requires. There is no reason why such different dispositions should be manifest between the sexes at this age. The avoidance of play or exercise, and the conventionalities of dress, explain in a large part the want of full and natural development so characteristic of the female sex at the age when they should present in every respect of form, health, and color, the picture of human physical perfection. As it is, the majority of them at twenty years of age are already pale and faded, unnatural in color, wanting in spirit and force, and give evidence of retarded or obstructed development. Where exceptions occur it is usually owing to a violation of the *régime* of the school. Many of our district schools are supplied with a large, well-lighted, and well-ventilated hall. This hall might be used every day in the week for systematic plays designed or contrived to call into active exercise the senses and the whole muscular system. The running leap of the German gymnasium should form a feature of the sports of this hall. Girls could loosen their waistbands and adopt a style of dress which would enable them to exercise their shoulders and arms. They might find in this practice healthful sport, and a means of developing the tissues of the arms and shoulders, which would result in the development of that beauty of form so highly prized and so frequently simulated by artificial means. The muscles of the hands and arms can be exercised by the play of grace-hoops, cast by the use of two wands, and caught in the same way. The game of shuttlecock, requiring the use of a light bat, alternately in the right and left hand, calls into activity sight and touch. It would not be difficult to contrive games of which young people would not grow weary, and which would without question insure for our feeble school-girls a more durable tenure of good health and a larger stock of force and endurance. While the school ignores the necessity of play to the young, society gives it questionable recognition, and that most potent ruler of society—Fashion—finds in it opportunities for the display of her power. Tennis and archery are resorted to for amusement, and would yield most abundant good exercise were

these games not subordinated to such exclusively polite practice that the dress of the players is even one of the chief requisites to the successful conduct of the game. The amusement is captured by the dressmakers and dudes, so that even this means of exercise without flannel suits and rubber-soled shoes is not regarded as permissible. As in dancing, the accessories become so elaborate and costly, and beset with so many formalities, that physical recreation is not expected from it. The game merely answers as a scheme to bring people together who are hankering for some opportunity to be near each other, and exchange the sentimental platitudes of unsatisfied and instinctive social emotions. If Gustave and Regina, at fifteen years of age, are to be improved by scurrying about in the manner and time of the modern waltz, then 'twere well that the latter were dressed so as to give her freedom of limbs and lungs, and the recreation given in the afternoon, so that regular sleep at proper time may allow that recuperation of energy and nourishment of wasted tissue consequent upon exertion. As Wesley remarked in apology for the liveliness of Methodist singing, 'It is not right for the devil to have all the best tunes,' so it may be said of dancing, that recreative means should not be monopolized by the social usages and occasions where circumstances exclude the greatest benefit from the exercise, and sometimes induce positively injurious consequences."

What is a Glacier?—The Philosophical Society of Washington, some months ago, had a symposium on the question "What is a Glacier?" Mr. I. C. Russell, taking both the Alpine and continental types into consideration, would define a glacier as an ice-body, originating from the consolidation of snow in regions where the secular accumulation exceeds the loss by melting and evaporation, or above the snow-line, and flowing to regions where loss exceeds supply, or below the snow-line. Mr. S. F. Emmons described a glacier as a river of ice, possessed, like the aqueous river, of movement and plasticity. The *nevé* field is the reservoir from which it derives not only its supply of ice, but the impulse which gives it its first movement. Mr. W. J. McGee held that the phenomena of glacier ice and *nevé* ice appear to belong to a graduating series; and in consequence the two phases can only be arbitrarily discriminated. Mr. W. H. Dall defined a glacier as a mass of ice with definite lateral limits, with motion in a definite direction, and originating from the compacting of snow by pressure. Mr. T. C. Chamberlin, disclaiming attempts to give a rigorous definition, thought the better distinction between *nevé* and glacier was genetic. There is an area of growth and an area of waste in every glacier. Superficially the area of growth coincides with the *nevé*; the area of waste with the glacier proper. Mr. C. E. Dutton said there was little difficulty in recognizing a glacier when all those features that characterize it are present, and where the conditions are of the ordinary nature; but exceptional cases arise to make an exact definition impracticable.

The Beauty of Old Wrought-Iron Work.—Mr. J. Starkie Gardner has observed, in a Society of Arts lecture on "Wrought-Iron," that old iron-work possesses interest and attractions which few examples of modern work can equal. This is partly because, estimating by the eye and working his scrolls by hand, the workman "produced an irregularity and play in even the most monotonous design which is artistically charming to us, but was perhaps even a source of chagrin to him." The modern smith works in a different way, and turns out uniform rods and scrolls, while he considers any irregularity a sign of bad smithing. The scarcity of straight bars among the oldest examples was probably due to the fact that it was extremely hard to handle a long bar and beat it out perfectly true with mathematically exact and sharp angles. Another element of artistic superiority in the older work lay in the fact that it was intrusted only to persons who had a special aptitude; and, if such a person were not forthcoming, the work was either not executed, or was made in the simplest form; while, if he were at hand, the details of the design were left to his fancy, and were, therefore, well within his own powers. It was the existence of the skilled smith that created the demand, rather than the demand that created the smith; and it seems a reasonable inference

that none such had to beg for work in the middle ages. When a grill was wanted for, say, Westminster Abbey, it was not the local man who had the commission, but a smith from wherever he might be found, who had a designing capacity and a skill of his own, who was fetched and maintained until the task was completed. The smiths of those days were probably not fettered by estimate or bound by time; but, we have a right to suppose, the art-work was produced for art's sake by a genuine artist.

New Kinds of Optical Glass.—Professor Abbé, of Jena, has been experimenting for many years with a view to produce an optical glass which should be free from the defects incidental to all silica glasses. In particular, he sought to produce a higher degree of achromaticity than was hitherto possible, by diminishing the secondary coloring effects inseparable from the ordinary silicate flint and crown glasses, and to produce a greater multiplicity in the gradations of optical glass in respect of the two great constants of the index of refraction and the mean dispersion. In silicate glasses, those two constants increase and decrease together. Cases often arise in which a different relation is desirable. Professor Abbé has produced glasses in which both objects are fulfilled. He has produced achromatic lenses of a more perfect kind than were ever before obtainable, and has introduced a whole series of new glasses of graduated properties. These glasses are offered freely to the trade without any restriction or patent being allowed to stand in the way of further development.

How the Krakatoa Dust was carried.—Mr. Ralph Abercromby introduces an account of his studies of the relation of the upper wind-currents near the equator, with the diffusion of Krakatoa dust, by showing that, as a rule, there is a continuous successive veering of the equatorial winds as we ascend. Standing with one's back to the surface wind, the upper currents will—north of the equator—come successively more and more from the left with increasing height; south of the equator, the rule is reversed. Nevertheless, some remarkable variances have been observed in the region between the equator and the doldrums. From the consideration of these exceptional cases the author concludes that when the trades or monsoons meet they do not interlace, as has been suggested by many, but the upper winds combine in a generally easterly current, and probably diverge only slightly pole-ward on either side. The velocity of this current is unknown. Applying this theory to the dust-flow from Krakatoa, as its advance was indicated by the view of green suns and red after-glows, the system of its movement will appear to have been very simple. "The great dust-stream was carried for the first twenty-four hours by the normal easterly upper currents over the south-east trade, at the extraordinary rate of more than one hundred and twenty miles an hour, but hardly extended north of the line. . . . In fact, we may say that the great stream of Krakatoa dust was carried nearly round the world by the usual upper winds of the south-east trade, in which the dust was first ejected at a rate of about one hundred and twenty miles an hour, and that the dust spread very slowly either north or south of the main current." The high velocity of one hundred and twenty miles an hour is certainly more than would have been expected; but, while we have very few observations of the rate of motion of the highest clouds, a number of those that we have give figures approaching this speed. So that the author is able to add: "There would be nothing, then, outrageous in the assumption of a velocity of one hundred and twenty miles an hour for the easterly current over the equator to account for the high speed of the diffusion of Krakatoa dust; and it is also satisfactory to know that the general direction of the flow is in accordance with the most recent researches on the vertical succession of the upper currents near the equator."

The Crater-Lake Chala.—Mr. J. A. Wray last year reached the edge of the water of the crater-lake Chala, on Mount Kilimanjaro, which Mr. Thomson saw and has described in his account of the mountain. The lake is about three miles long by one mile wide, with banks so steep that a descent to the water is impossible, except at one place on the western side. Mr. Wray found the water clear, cool, and perfectly sweet, though

the lake has no apparent inlet or outlet. It contains fish, and numerous water-fowl were swimming on its surface, the flapping of whose wings, when they took to flight, produced a sound, through confused reverberation in the deep, well-like basin, like the rushing of a distant railway-train. The steep banks, about one thousand feet in height, are well wooded, and vegetation clothes their surface down to the water's edge. There is no mark of higher water, and it probably keeps the same level all the year round. The cries of birds had a peculiar sound, and Mr. Wray believed that it is these noises that have given rise to the native myth that a Masai village formerly stood here, which was swallowed up by the lake. The people of Taveta believe that they hear voices, the lowing of cattle, etc.

Black Bears.—Mr. William Pittman Lent gives an interesting account of the "Black Bear" in the "Transactions" of the Ottawa (Canada) Field Naturalists' Club. The young of bears are produced in March, and no female has been killed by Canadian hunters, before or after the hibernating season, that showed any evidence of being in the gravid state. The cubs are very small—not larger, when two days old, than kittens of the same age. The animals feed principally on vegetable food—grapes, roots, berries, beechnuts, oats, and Indian corn. They sometimes visit the oat or corn fields before sunset, and may be taken there by a skillful hunter. They are inordinately fond of honey, and they feast luxuriously in the fall on the berries of the mountain-ash. When their natural food is scarce they visit the farm-yard and carry off pigs and sheep, and will even kill young cattle when pressed for hunger. They are also fond of fish; they have been known to wade and swim in the rivers for the purpose of catching them, and are frequently to be seen along the coast of the island of Anticosti, devouring herring-spawn. They are active, though clumsy, and will run for a mile or two with astonishing speed. When closely pursued by dogs, a bear will take to a tree, up which he can climb rapidly, but from which he descends more slowly, head upward, as soon as it appears safe to do so. They are very shy and timorous in the presence of man, and will make off rapidly when they perceive a human being by sight or scent, but they are most affected by the scent. The black bear fights with teeth and claws, and by hugging. When in an erect position he is a perfect master of the art of self-defense, and it would puzzle a pugilist to get in a blow at him. His most vulnerable part is the nose, which is provided with many sensitive nerves intimately and directly connected with the brain. When a bear is standing on all-fours, there would be no difficulty in striking him with a club; but, when he is sitting erect, it would be an entirely different matter. In Canada black bears retreat to their dens—generally under the roots of large trees, or occasionally in rocky caves—at about the setting in of the season of confirmed frost and snow. They remain there in a quiescent state, although not—as has been well established by hunters who have killed them in their dens in the depth of winter—in a trance-like condition of torpidity, till the opening of spring. When they first emerge from their four months' slumber they are heavy and fat, and their fur is in prime condition, but shortly afterward they fall off in flesh, and soon become ragged in coat and lanky in appearance. Toward October, if they have had a favorable summer, they are found in good condition, and at any time after the middle of November their skins have the finest color, and the thickest and heaviest coat of fur. Bears are still found within eight or ten miles of the city of Ottawa. Even the black bear, Mr. Lent thinks, is of sufficient importance in the economy of Nature and of man to entitle him to legal protection.

Useful Reptiles.—When we have secured protection to the birds, it will be time to teach the people to have more mercy on the reptiles. The popular, almost unconquerable prejudices against this class of animals are regarded by science as mistaken except as to a very few kinds, but the public still need enlightenment on the subject. Professor O. P. Hay has embodied a popular lesson on the innocence and even value of most reptiles in his paper on "The Amphibians and Reptiles of Indiana," which, being comprised in the State Agricultural

Report, will reach all the inhabitants of at least one commonwealth. "Many amphibians and reptiles," he says, "are of direct value to man. Many, as various kinds of turtles and frogs, are used as food, and such might even be profitably bred for that purpose. Many others are useful because of their propensity for devouring insects, mice, and rats, that are the pest of the farmers. A few, indeed, are dangerous; but it is worth any person's while to study our reptiles, if for no other reason than to be freed from constant fear of them. Of nearly a hundred species of amphibians and reptiles to be found within Indiana, not more than three or four are poisonous, and these are of rare occurrence. . . . Some others may strike, or bite a little, or constrict, as they have a right to do, but they are not venomous, and can do little hurt. Snakes that roll along like hoops, snakes that blow poison, snakes that sting with their tongues or the tips of their tails, and snakes that live for weeks in people's stomachs, are creatures of the imagination. Therefore, considering their usefulness as destroyers of vermin, no amphibian or reptile ought to be killed, unless it is to be employed for practical uses or preserved as a specimen for scientific purposes. . . . If the boys of the country are to be allowed to shoot all the birds and stone to death all the reptiles, we may yet be compelled to surrender to the vermin."

How the Glacial Drift was deposited.—The manner in which the glacial drift was deposited by the great ice-sheet has been studied by Professor O. P. Hay as a problem whose solution has not yet been effected. One of the difficulties in the way of comprehending it originates in the fact that all our analogies are derived from the observation of modern glaciers in motion down steep inclines, while we do not fully recollect that the great glacier in question most probably came to a standstill in level territory. Bearing this point in view, the author concludes that a glacial ice-sheet moving over a nearly level surface would possess far less power of abrading its bed than the same glacier would have while descending a slope of high angle; through subsidence of the glacial mass, caused by the earth's heat, and through other influences, a constantly increasing proportion of inert materials would collect in the lower layers of the moving ice; the accumulation of such materials would tend to retard the motion of the lower portions of the glacier, and, finally, when they formed a sufficiently great proportion of the mass, all motion of the lower portion would cease, and a permanent deposit would begin and continue to be made; other masses of detritus might be deposited at the foot of the glacial ice-sheet as a terminal moraine, and still other masses on the top of the already formed deposit when the glacier finally melted.

Mineral Constituents of Food.—In considering the different food-stuffs, says Dr. N. A. Randolph, we must regard water as of prime importance. In the average adult it constitutes from fifty-nine to sixty-five per cent—or even larger proportions, according to other estimates—of the entire weight. We must regard it as an essential condition for the manifestation of all total phenomena. Certain solid inorganic elements of food are also essential to the well-being of the organism, for in their absence the tissues can not be properly built up, nor can the processes in either the solids or the fluids of the body go on. The presence of mineral constituents appears absolutely essential to the integrity of proteid matter, and their withdrawal entails a loss of most of its distinguishing characteristics. A striking illustration of the necessity of this class of food-stuffs, and of the disturbances resulting from a very slight diminution in the amount of inorganic constituents present in the economy, may be found in the recent experiments of Ringer. Minnows, which thrived in brook-water, and remained alive in it without food for many days, died in a few hours when placed in distilled water properly aërated. Examined more closely in detail, the inorganic elements of food consist of the salts of the alkalies, salts of the alkaline earths, iron, silica, and fluorine in various combinations. The importance to the economy of the carbonates of the alkalies, and therefore the importance of fresh vegetable food from which they are most readily elaborated, must not be under-

estimated. Of the uses of potassium chloride but little is known. Sodium chloride, however, or common salt, has been more closely studied. In such proportions as the healthy taste demands, it is undoubtedly a valuable stimulant to the nutritive processes. The extent of the need for lime-salts in young animals is surprising. Iron is undoubtedly a food; for the quantity in the system is restored as fast as it is eliminated. Contrary to popular belief, the major portion of the iron of the human body is found, not in the blood but in the muscles, even after their contained blood has been removed. Silicic acid is found in very small quantities in bones, hair, and blood. It is supplied by many vegetable foods. Calcium fluoride is found in teeth, and to a slight extent in bone. Fortunately for us, these inorganic foods, whose withdrawal exercises deleterious influences on the economy, are, as a rule, present in great quantity in the actual foods in a mixed diet. In certain methods of preparing foods, however, their proportion is much diminished; thus, in the boiling of meats and vegetables, a large quantity of these important foodstuffs is extracted. Indeed, one of the chief dietetic advantages of salads and uncooked vegetables in general is, that these elements have not been removed.

Why do our Teeth decay so fast?—To this question Dr. Julius Pohlman answers, because we do not use them enough—showing that as a rule "those people who are least acquainted with the so-called hygiene of the teeth are the happy possessors of the soundest dentition"—like the negroes who chew sugar-cane, the German peasants, who are famous for their brilliant "Schwartzbrot-Zähne," or "rye-meal-bread teeth," polished but not worn out by daily mastication of dry, hard, black loaves, and the few old people left among us who persist in eating bread-crusts. Our weak and effeminate teeth are not used to hard work, and, like other organs that are not exercised, tend to atrophy. "The foundation for bad teeth," says this author, "is generally laid in early childhood; for numberless mothers and nurses very carefully soften the food or remove the crust from the bread before giving it to the little folks, because it may otherwise 'hurt their teeth,' and so the child grows up with a set of unused organs in its mouth; and when we have finally succeeded by the creation of artificial conditions in producing weak organs, then we wonder why the poor child has such bad teeth, and why it is so often suffering with toothache, and why the dentist's bill is so high. Teeth are organs specialized to perform the work of mastication; they are subject to the same laws that govern other organs, and their strength is determined by their use. Understanding this, we are obliged to admit that, if we ever become a toothless race, it will be our own fault."

Antiseptic Properties of Coffee.—The stimulating effects of the infusion of coffee have been referred to its excitant and tonic properties. Recent researches indicate that it has still more valuable qualities—those of an antiseptic. In 1885 M. Oppler announced the property which it possesses of preventing, to a certain extent, the development of micro-organisms in substances liable to putrefy. Then M. Sucksdorff showed that infusions of coffee and of tea might remain exposed openly to the air for a considerable time without molding or developing bacteria. Finally, Mr. Heim has recently published the results of more exact researches, which tend to demonstrate the reality of the antiseptic properties of roasted coffee. The cholera bacillus appears to be one of the organisms most readily affected by coffee. It is desirable to have the investigation extended to the infusion of tea, which will probably be found to have similar properties.

A Crystal Skull.—Among the interesting features at the meeting of the American Association was the exhibition, by Mr. George F. Kunz, of a crystal skull which had been brought from Mexico by a Spanish officer before the French invasion, and, having been in possession of Mr. Evans, the English collector, and Mr. M. E. Boban, now belonged to Mr. George H. Sisson, of New York. The inclusions in the rock-crystal material were identical with those in the quartz or rock-crystal from Calaveras County, California. Nothing more than this is known of the origin of the skull. It is

not Chinese, or nature would have been more faithfully copied; nor European, for the work would have been more carefully finished. Professor Morse, who has resided in Japan, and Mr. Tatin Basha, a Japanese, aver that it is not of that origin, Mr. Basha remarking that a skull is not considered a fit decorative object in Japan. Large masses of crystal have been found in the California locality, and small skulls made of the same material, measuring rarely more than two inches across, have often been brought from near Pachuca, in the State of Michoacan, Mexico. The skull weighs one hundred and seventy-five and one quarter ounces. The eyes are very deep hollows. The line separating the upper from the lower set of teeth has evidently been produced by a string, either held in the hand or stretched across the bow, and is very characteristic of Mexican work. The skill of these people in making such objects has been questioned, but the large masks, mirrors, and other articles of obsidian; the objects of agate, and the numerous jade and jadeite ornaments; and the fact that they made small skulls of rock-crystal and skulls inlaid with turquoise—to the fashioning of which the making of this skull was as nothing—all indicate that they might have made a large skull if a suitable stone came into their possession. Since they procured their turquoise from Los Cerilles, New Mexico, why should we doubt that they were acquainted with the California locality for rock-crystal?

The Nest of the "Purse-Web" Spider.—Among the natural-history papers read in the British Association was one by Dr. H. C. McCook, describing the nesting habits of the spider *Atypus niger* of Florida, a species which it has been found was first observed and figured, as the "purse-web spider," by John Abbott, in 1792. The nests of the Atypus are silken tubes of close texture and various lengths and sizes, which are spun against the bark of trees in nearly equal proportions above and below the surface of the ground. Some of the tubes are from twelve to fourteen inches long, and from one half inch to three quarters inch in diameter; others—the nests of the young—are a few inches long and of the thickness of a pipe-stem. The inside of the nests is white and clean; the outside is weather-stained and covered with sand. In spinning these tubes the spider first stretches a series of straight threads from a point on the bark about an inch and a half above the ground. These lines are more or less approximated, and present the appearance of a rough framework for the tube. Upon them the architect places a thickening of spinning-work, which is beaten down and spread over by the long spinners, the process resembling more that of a plasterer than of a weaver. The work is done in small sections, until the original frame is quite covered in. The lengthening of the tube is accomplished by adding to the original section until the desired length is attained. The new-made tubes were found covered on the outside with sand. The spiders were not seen in the act of sanding their nests, but a similar habit in *Atypus piceus* of England has been observed and described by Mr. F. Enock, who has discovered that the sand is forced through the texture of the web from the inside. The idea of mimicry has been advanced in connection with this nest-sanding. Certainly the tube does closely resemble the tree to which it is attached. But Mr. Enock's observations indicate that the spider has taken a convenient way of getting rid of the sand brought up by its mandibles from the excavations of its burrow below the surface.

Insects resembling Minerals.—Mr. Edward B. Poulton, discussing the resemblances which certain insect-pupæ seem to bear in color to the surface on which they are found, thinks it probable that the gilded pupæ of *Vanessidæ* (butterflies) resemble glittering minerals, like mica, which is very common in many places. Their shape is very angular, and like that of minerals. Conversely, the gray pupæ resemble gray and weathered rock-surfaces; and the two conditions of rock would themselves act as a stimulus for the production of pupæ of corresponding color. The power was probably gained in some dry, hot country where mineral surfaces do not weather quickly. Once formed, it may be used for other purposes, and in certain species probably con-

veys the idea to enemies that the insect is inedible. It is interesting to note how the *Vanessidæ*, primarily colored so as to resemble mineral surroundings, are modified for pupation on plants.

NOTES.

That teachers are alive to the defects of existing systems of public instruction—for which they are not usually responsible—is shown in the criticisms made against them by Mr. George L. Guy, in his address before the Southern Illinois Teachers' Association: "Are the young women of our time," he asks, "trained in those things which mothers most need to know? Are they being prepared properly for domestic life? If not, the vigor and happiness of the individual and of the race must diminish, and the educational system that has neglected the essential elements of a woman's life must take its place with other useless excrescences. . . . Does our bookish education, in any sense, fit our young people to enter upon the practical duties of life? Clearly it does not. Our method of instruction must be molded by a more thorough knowledge and consideration of the real needs of every human being."

Experiments in tasting are reported in the "Transactions" of the Kansas Academy of Science as having been performed by E. H. S. Bailey and E. C. Franklin upon forty persons, to determine the relative bitterness of different substances. Strychnine led the list of seven vegetable bitters. The average results in each case are represented in the following series: Of salicine it is possible to detect one part in 12,000 parts of water; of morphine, one in 14,000; of quinine, one in 76,000; of quassine, one in 90,000; of picrotoxine, one in 197,000; of aloine, one in 210,000; and of strychnine, one in 826,000. Twelve of the tasters were able to detect one part of strychnine in 1,280,000 parts of water.

The great industrial institution in Berlin, according to the account of Professor Sylvanus P. Thompson, occupies a very large building, which is situated in a domain of about twelve acres. It is aided by the state, and gives instruction in every known industry. It has about 500 rooms for technical teaching, and a good library. It cost, all fitted out, $4,800,000, or about as much as a British ironclad, and is maintained at an expense of about $190,000. This expenditure and the original outlay are recouped by the well-to-do character of the pupils who pass through its teaching, and become useful members of society instead of burdens and pests.

A curious story of "A Reasoning Lobster" is told by Willard Nye, Jr., in the "Bulletin" of the United States Fish Commission. The sagacious crustacean's home was under a rock in Buzzard's Bay, in water about five feet deep. The author carefully adjusted a noose over the hole, and baited it with a piece of menhaden. The lobster passed its claw through the noose to get the bait; and the noose was drawn upon the claw, but slipped off when the animal had been pulled half out of his hole, and he escaped. The noose was fixed again, but this time, instead of putting out his claws as before, the lobster first put his feelers through the noose, felt the string all the way around, and then pushed one claw under the string and seized the bait. The experiment was repeated several times, but every new setting of the trap was met in the same deliberate way, as if by one who had thought the matter out.

The gypsies of Transylvania, according to a writer in "Blackwood's Magazine," teach young bears to dance by placing the animal on a sheet of heated iron, while the trainer plays on his fiddle a strongly accentuated piece of dance-music. The bear, lifting up its legs alternately to escape the heat, involuntarily observes the time marked by the violin. Later on the heated iron is suppressed, when the animal has learned its lesson; and whenever the gypsy begins to play on the fiddle, the young bear lifts its legs in regular time to the music.

It is said that forty per cent of all the deaths from poison in Great Britain are due to opium; and this rate of mortality, according to Dr. Wynter Blythe, "arises in a great measure from the pernicious practice, both of hard-working English mothers and the baby-farmer, of giving infants 'soothing-sirups,' 'infants' friends,' and the like, to allay restlessness and keep them asleep during the greater part of their existence." It has been calculated that one preparation alone is the undoubted cause of death of 150,000 children every year.

Professor W. Mattieu Williams convicts the enemies of physiological experiment of inconsistency by showing that all male animals that come fully grown to market, as they must know, are subjected to one of the most painful mutilations that can be performed, merely to improve the flavor of their flesh. "A prominent member of the screeching sisterhood," he says, "has been seen lounging in her carriage drawn by a pair of horses that have been thus tortured for her luxurious convenience. To this she is supremely indifferent, but raves most virtuously against those who puncture the skin of a dog or rabbit in order to save thousands of human beings from cruel disease."

Mr. Harris, of the Institute of Civil Engineers, contradicts the belief, which is general, that mine-explosions are always accompanied by a low barometer. Very few of the explosions of 1886 and 1887 were thus accompanied; and out of the list of disasters in the eleven years 1875–'85, given by Sir Frederick Abel, only 18·75 per cent of the accidents and 17·4 per cent of the deaths occurred when the mercury was at 29½ inches or below. One half of this small percentage of explosions took place with a low but rapidly rising barometer, when gas had begun to issue from the strata.

Mr. Francis Galton has described his ideal of an anthropometric laboratory as a place where a person may have any of his various faculties measured, and where duplicates of his measurements may be preserved as private documents. Besides the ordinary simpler apparatus, such an institution should contain instruments for psycho-physical research, for determining the efficiency of each of the various senses and certain mental constants. Instruction might be afforded to those who wish to make measurements at home, together with information about instruments and the registration of results. A library would contain works relating to the respective influences of heredity and nurture. It might also fulfill a welcome purpose as a receptacle for biographies and family records.

Otto Wiener, having made certain measures of the thickness of a film of silver which can just be perceived by the eye, concludes that 0·0000002 of a millimetre is an upper limit of the diameter of a silver molecule.

Mr. W. H. Preece said, in papers read in the British Association on "Copper Wire," with particular reference to its use in telegraphy and telephony and high-speed telegraphy, that the speed of transmission on inland circuits had increased from eighty words per minute in 1870, to six hundred in 1887, and on the most difficult line to Dublin, from fifty words in 1870 to four hundred and sixty-two in 1887. In fact, as many words could now be transmitted on one wire as on nine in 1870. Those improvements had been the results of greater perfection in apparatus, the elimination of electro-magnetic inertia, the improvement of the circuits (the wire and its surroundings), and the introduction of high-speed repeaters.

OBITUARY NOTES.

George W. Tryon, Jr., the distinguished conchologist, died at his home in Philadelphia, February 5th. He was conservator of the conchological collections of the Academy of Natural Sciences of Philadelphia, which is said to outrank even those of the British Museum, and was himself the owner of the most numerous collection in the world. He spent the later years of his life in arranging and systematizing the Academy's collection. He prepared the "Manual of Conchology, Structural and Systematic," which, although it has reached its fourteenth volume, is left unfinished. He was the author of a work on the marine conchology of the eastern United States and of a general manual of recent and fossil conchology, and was one of the founders and editor of the "American Journal of Conchology." His fame was world-wide, and his standing among conchologists in the highest rank.

Dr. Joseph B. Holder, Curator of the American Museum of Natural History, died suddenly at his home in this city, February 28th. He had been connected with the museum for several years, and had taken an important part in the arrangement and classification of its collections. He was a frequent writer on subjects connected with his lines of work, being the author of many articles in public journals, magazines, and scientific periodicals, and of books.

Emil Rousseau, a French chemist, died in Paris, February 4th, in the seventy-fourth year of his age. After working in the laboratories of Orfila and Dumas, and in the Central and Municipal Schools, he established a manufactory of chemical products, at which subsequently Sainte-Claire Deville and Debray with his aid worked out the industrial fabrication of aluminum. He first applied pyrites to the fabrication of sulphuric acid, introduced a new preparation of charcoal, and devised the sugar process known as the Rousseau process.

The death is announced of Dr. J. T. L. Boswell, a well-known English botanist, who was for many years Curator to the Botanical Society in London.

Anton de Bary, the eminent botanist of the University of Strasburg, died January 19th after a painful illness. He was born in 1831, was Professor of Botany successively at Freiburg, Halle, and Strasburg, was famous for his researches on the algæ and fungi, was for many years after 1867 editor of the "Botanische Zeitung," and was the author of numerous treatises chiefly relating to cryptogamic vegetation, physiology, and morphology.

Mr. George Robert Waterhouse, late keeper of the department of geology in the British Museum, died on the 21st of January, in the seventy-eighth year of his age.

INDEX.

PAGE

Abbe, Cleveland, Sketch of..... 400
Abercromby, The Hon. Ralph..... 648
"Act of God," The, and "Human Responsibility" (Editorial)..... 555
Advance, A Further (Editorial)..... 128
Advances, Recent, in Sanitary Science..... 186
Agassiz and Evolution (Le Conte)..... 17
Agassiz's Service to Evolution..... 717
Alaska and its Tundra..... 711
Albumen, Vegetable and Animal (Bernhardt)..... 541
Allen, Grant..... 189
Amazons, The Table-Topped Hills of the..... 137
American Cinquefoils (Allen)..... 189
American Zoölogists, What, have done for Evolution (Morse)..... 100, 492
Argyll, The Duke of..... 241
Astrologers, Persian..... 141
Astronomical Agency, A Central..... 282
Astronomy, Photography as an Aid to..... 426
Astronomy with an Opera-Glass (Serviss)..... 58, 111
Athletics, College, and Physical Development (Richards)..... 721
Atmospheric Dust, Accumulations of..... 712
Atwater, Professor W. O..... 76
Audubon, The Proposed Monument to..... 281

Baeyer, John Jacob, Sketch of (Gore)..... 261
Bartol, H. W..... 236
Basements, The Unhealthfulness of (Stillman)..... 114
Bayou, What is a? (Williams)..... 123
Bears, Black..... 859
Beauty, The, of Old Wrought-Iron Work..... 857
Beebe, Edward H..... 122
Bees, Some Notes about..... 187
Bernhardt, W..... 541
Berthelot, M. P. E..... 220
Binet, A., and Féré, C..... 763
Bissell, Mary T., M. D..... 504
Blake, Henry A..... 682
Boas, Dr. Franz..... 628

Books noticed: PAGE

Abercromby, Hon. Ralph. Weather 704
Adams, H. B. College of William and Mary 131
" Literature of Charities 416
Allinson and Penrose. The City Government of Philadelphia 279
Andrews, Benjamin. Institutes of General History 275
Ashley and Hutton. English History from Contemporary Writers 273
Ashley, W. J. Edward III and his Wars 273
Bain, Alexander. On Teaching English 850
Baird, Spencer F. Report of Smithsonian Institution, 1885–'86 417
Baldwin, Joseph. Elementary Psychology and Education 560
Bancroft, H. H. History of the Pacific States—Popular Tribunals 272, 562
Barrows, C. H. Facts and Fictions of Mental Healing 130
Barus and Strouhal. Physical Properties of the Iron Carburets 420
Barus, Carl. Subsidence of Fine Solid Particles in Liquids 420
Beal, W. J. Grasses of North America 131
Bert, Paul. Introductory Steps in Science 706
Binet, A., and Féré, C. Animal Magnetism 848
Biological Society of Washington, Proceedings, 1884 to 1886 564
Bishop, G. R. Exact Phonography 852
Board of Education, New York City—Forty-third Annual Report 279
Brewers' Association, United States, Proceedings of Convention, 1887. 277
Brinton, D. G. Ancient Nahuatl Poetry 561
" Conception of Love in American Languages 565
Brown, John A. Palæolithic Man in Northwest Middlesex 130
Bryce, James. Predictions of Hamilton and De Tocqueville 416
Bugbee, J. G. The City Government of Boston 279
Bureau of Education, Circular No. 1 131
Butler, J. S. Curability of Insanity, etc 132
Butler, N. M. The War of 1812 and the Consolidation of the Union .. 416
Byerly, W. E. Chauvenet's Treatise on Elementary Geometry 135
Carroll, Lewis. The Game of Logic 278
Chief Signal-Officer, Report for 1886 849
Cooper, Sarah. Animal Life in the Sea and on the Land 707
Da Paz, Campos. A Questão dos Vinhos 421
Dexter. Astronomical Revelations 567
Diller, J. S. Geology of Northern California 419
" Peridotite of Elliott County, Kentucky 420
Dimitry, John. Three Good Giants 415
Dolbear, Professor A. E. The Art of Projecting 850
Downing, A. J. Cottage Residences 567
Ebers, Georg. Richard Lepsius 850
Engelmann, G. J. Use of Electricity in Gynecological Practice 133
Everett, J. D. Outlines of Natural Philosophy 707
Fairchild. History of the New York Academy of Sciences 275
Finck, H. T. Romantic Love and Personal Beauty 128
Fish Commission of the United States, Report for 1885 564
Forest Commission, State of New York, Second Annual Report 567
Froebel, F., and Hailman, W. N. The Education of Man 707
Garlanda, Federico. The Fortunes of Words 134
Gilman's Historical Readers 130

Books noticed: PAGE
Gilson. Trees of Reading, Massachusetts 851
Grove, Sir George. A Dictionary of Music and Musicians 417
Haddon, A. C. Introduction to the Study of Embryology 134
Hall, G. Stanley. American Journal of Psychology 558
Halsted, B. D. Botanical Bulletin, Iowa Agricultural College 566
Harris, W. C. Fishes of North America 568
Heilprin, Angelo. Explorations on the West Coast of Florida 418
Herrmann, Gustav. The Graphical Status of Mechanism 132
"How I was Educated" Papers 851
Hutton. The Misrule of Henry III 278
Imperial University, Japan, Journal of the College of Science of 421
Jackson, E. P. The Earth in Space 855
Jones, L. E. The Best Reading 566
Jones, W. H. Federal Taxes and State Expenses 278
Johonnot, James. Stories of Our Country 567
Jordan, D. S. Science Sketches 563
King, C. W. The Gnostics and their Remains 559
Kirkup, Thomas. An Inquiry into Socialism 849
Knox, T. W. Decisive Battles since Waterloo 563
Langley, S. P. The New Astronomy 854
Laughlin, J. L. Elements of Political Economy 271
Lincoln, Mrs. D. A. Boston School-Kitchen Text-Book 560
Linderfeldt, K. A. Text-Book of Volapük 280
Lloyd, J. H. Moral Insanity in Medico-Legal Aspects 134
Love, S. G. Industrial Education 275
McCalley, Henry. On the Warrior Coal-Field 416
McGee, W. J. Meridional Deflection of Ice Streams 422
" Relations of Geology and Agriculture 566
Marks, W. D. The Relative Proportions of the Steam-Engine 415
Miles, Manly. The Microbes of Nitrification 421
Miller, A. J. Dress 850
Miller, L. W. The Essentials of Perspective 274
Mills, W. T. The Science of Politics 559
Mitchell, F. A. Ormsby Macknight Mitchell 853
Morrison, G. B. Ventilation and Warming of School-Buildings 849
Müller, F. Max. Biographies of Words 851
Nelson, Dr. Wolfred. Difficultés dans la Construction du Canal de Panama 420
New York State Board of Health, Examination of Beers 277
Norman, Henry. Bodyke 276
Oldberg, Oscar. Manual of Weights and Measures 132
Oleomargarine Question, The, An Abstract of 418
Oliver, J. A. W. Astronomy for Amateurs 853
Patton, J. H. Natural Resources of the United States 853
Peabody Museum, Twentieth Annual Report of the Trustees 417
Peale, A. C. Mineral Springs of the United States 419
Peck, W. G. Elementary Treatise in Determinants 278
Peters, E. D. Modern American Methods of Copper-Smelting 565
Philosophical Society of Washington, Bulletin for 1886 277
Powell, E. P. Our Heredity from God 413

Books noticed: PAGE
Powell, J. W. Sixth Report of United States Geological Survey..... 278
Proctor, R. A. Half-Hours with the Stars 854
Quackenbos, J. D. Appletons' Physical Geography..... 126
Ridgway, Roberts. Manual of North American Birds..... 705
Riley, C. V. Entomological Report, 1886—Experiments with Insecticides—Our Shade-Trees and their Insect Defoliators..... 565
Roemer, Jean. Origins of English People and Language..... 702
Roos, Dr. P. F. Van Hamel. Revue des Falsifications des Denrées Alimentaires..... 419
Saintsbury, George. History of Elizabethan Literature..... 708
Salomons, Sir David. Management of Accumulators..... 855
Sansone, Antonio. The Printing of Cotton Fabrics..... 127
School of Expression, Boston. Second Annual Report..... 564
Scudder, S. H. Present Knowledge of Fossil Insects..... 419
Seifert, O., and Müller, F. Manual of Clinical Diagnosis..... 568
Snow, M. S. The City Government of St. Louis..... 133
Society for Promotion of Agricultural Science, Seventh Meeting..... 421
Spencer, T. C. The Struggle for Religious and Political Liberty..... 132
Sprague, C. E. Hand-Book of Volapük..... 280
Stevenson, R. L. Memoir of Fleeming Jenkin..... 706
Sutton, J. B. Ligaments, their Nature and Morphology..... 135
Thomann, G. The Effects of Beer..... 277
Thoreau, H. D. Winter..... 567
Upham. Beeches and Deltas of Lake Agassiz..... 420
Van Dyke, J. C. The Principles of Art 274
Vermeule, C. C. Topographical Survey of New Jersey..... 280
Von Förster, Max. Compressed Gun-Cotton..... 133
Walcott. Cambrian Faunas of North America..... 419
Walker, Jerome. Health Lessons..... 134
Ward, L. F. Synopsis of the Flora of the Laramie Group..... 421
" Types of the Laramie Flora..... 420
West, M. A. Childhood: its Care and Culture..... 708
White, C. A. Laramie and Fresh-Water Eocene Fauna..... 420
White, J. C. Dermatitis Venenata..... 132
Whitman, C. O., and Allis, E. P. The Journal of Morphology..... 852
Williston, S. W. Synopsis of the North American Sylphidæ..... 133
Withington, C. F. Transmission of Disease by Rags..... 566
Wood, H. C. Nervous Diseases and their Diagnosis..... 132
Wurtz, A., and Greene, W. H. Elements of Modern Chemistry..... 563
Boomerang, The..... 283
Borrowing without Credit (Editorial)..... 702
Bowen, Eliza A..... 267
Bright's Disease, Origin of..... 573
Britain, The Making of..... 716
Brown University, The Scientific Department of 423
Building-Stone, Protection of..... 713

Californian Dry-Winter Flowers (Halsted)..... 770
Cameo-Cutting for Amateurs..... 715
Cameos..... 284

PAGE

Cancer, Recent Views respecting (Morris) 534
Candy, A Paper of (Kennedy) 782
Catastrophes, Are there? 141
Cattell, J. McK 488
Cattle, The Wild, of New Zealand 718
Centralization in School-Life 424
Character, The Cause of 821
Chemistry, The, of Underground Waters (Daubrée) 873
Chinese in America 136
Cincinnati, The Hills and Valleys of 282
City, A Rock-Sculptured 142
Clarke, Professor F. W 799
Climate of the Lake Region (Hubbard) 373
Clouds, Iridescent 712
Coffee, Antiseptic Properties of 861
College Athletics and Physical Development (Richards) 721
Conklin, W. A 122
Consciousness, The Antechamber of (Speir) 657
Copyright, International (Editorial) 409
Coral Reef, Glimpses of Life along a (Herrick) 315
Correspondence 122, 266, 554, 697, 841
Counterfeiting Gems 425
Country Boys, The Scientific Privileges of 571
Crater-Lake, The, Chala 858
Cross-Timbers, The, of Texas 427

Dangers, The, of Receiverships (Bartol) 236
Darwin's Education (Editorial) 698
Darwin's Working Life, Glimpses at (Larrabee) 619
Darwin, The Boyhood of (Darwin) 208
Daubrée, Professor G. A 610, 813
Davies, H. Brooke 96
Dawson, Sir William 787
Diatoms, The Nature of 142
Disinfection by Heat and by Steam 716
Disturbances, The Economic, since 1873 (Wells) 1, 170, 289, 455, 577
Dust, Electrical Deposition of 140

Earthquake, an, Effects of 717
Economical Plants, New 571
Economic Disturbances, The, since 1873 (Wells) 1, 170, 289, 455, 577
Economic Outlook, The (Wells) 577
Edible Birds' Nests, What they are made of 284
Edison's (Mr.) Pyromagnetic Dynamo 138
Editor's Table 123, 267, 409, 555, 698, 842
Eimer, Professor Theodor G. H 26
Electric Tractive Adhesion 573
Erysipelas, Vaccination and 715
Evolution, A Difficulty regarding 554
Evolution, An Alleged Argument against (Editorial) 267

PAGE
Evolution and Religious Thought (Le Conte)..... 311
Evolution, What American Zoölogists have done for (Morse)..... 100, 492
Evolution: What it is Not, and What it Is..... 636
Exceptions to the Rule of Laissez-Faire..... 138
Exhibition, The International Competitive, at Brussels..... 424
Explosives, Efficiency of..... 714

Fernald, Frederik A..... 87
Fernow, B. E..... 225
Fibers, Mineral..... 430
Fictional Astronomy (Beebe)..... 122
Fielde, Adèle M..... 796
Figs, The Time of (Huntoon)..... 842
Fig-Tree, "The Blighted," Professor Huxley and (Huntoon)..... 697
Fishes, The Family-Life of (Hennings)..... 777
Flamingoes at Home (Blake)..... 682
Flora, North American, Antiquity of..... 570
Flowers, Californian Dry-Winter (Halsted)..... 770
Food, Mineral Constituents of..... 860
Forestry-Problem, Our (Fernow)..... 225
Fruit-Diet, Some Advantages of..... 710
Fungi, Parasitic, Injuries caused by..... 428

Geography, Geikie on the Teaching of (Fernald)..... 87
Glacial Drift, How the, was deposited..... 860
Glaciation on the Pacific Coast..... 429
Glacier? What is a..... 857
Glass, Optical, New Kinds of..... 858
Glass-Snake, a, Dissection of (Conklin)..... 122
Gore, J. H..... 261
Granger Movement, The Outcome of the (Pierson)..... 368
Granger Movement, The Rise of the (Pierson)..... 199
Graphite, What is?..... 283
Gray, Professor, Death of (Editorial)..... 845
Greene, Thomas L..... 697
Ground-Water and Health..... 285
Guessing, Curiosities of..... 572

Hale, Horatio..... 340
Halsted, Professor Byron D..... 770
Handiwork Teaching in Swedish Schools..... 713
Health, Ground-Water and..... 285
Heating, Roundabout..... 574
Henderson, Professor C. H..... 529
Hennings, Karl..... 777
Herrick, Francis H..... 315
How it works (Editorial)..... 841
Hubbard, Bela..... 373
"Human Responsibility," The "Act of God" and (Editorial)..... 555
Huntoon, J. W., M. D..... 697, 842

PAGE
Huxley, Professor, and the "Blighted Fig-Tree" (Huntoon)..... 697
Huxley, Professor T. H..... 166, 352, 732
Hypnotism in Disease and Crime (Binet and Féré)..... 763

Ice-Supply, Our, and its Dangers (Prudden)..... 668
Idiosyncrasies of Plants..... 142
Indians, The, of British Columbia (Boas)..... 628
Indian Villages in New York..... 427
Individuality in our Schools (Marvin)..... 841
Inheritance, Curious Facts of..... 688
Insects resembling Minerals..... 862
Instruction, Oral and Text-Book..... 574
Interference, Governmental, with Production and Distribution (Wells)..... 289
International Copyright (Editorial)..... 409
Interstate Commerce Law, The (Greene)..... 697
Interstate, The, "Long and Short Haul" (Wood)..... 537
Inventions at Panama (Weld)..... 145

Jackson, J. Hughlings, M. D..... 327
Joking, The Psychology of (Jackson)..... 327

Kappler, August..... 396
Kellogg, Theodore H., M. D..... 387
Kennedy, William Sloane..... 782
Kitchen College, A (Davis)..... 96
Krakatoa Dust, How the, was carried..... 858

Laissez-Faire, Exceptions to the Rule of..... 138
Lakes, Siberian, The Drying up of..... 139
Language, Race and (Hale)..... 340
Larrabee, William H..... 619
Law, The Forms and Failures of (Snyder)..... 751
Le Conte, Joseph..... 17, 311
Lesson, A Great (Argyll)..... 241
Lime-Salts in the Food and the Teeth..... 716
Liquors, Strong, Origin of..... 140
Literary Notices..... 126, 271, 413, 558, 702, 848
Literary Piracy, English..... 424
Lockyer's (Mr.) Theory of the "Cosmos"..... 569
Long and Short Haul, The (Wood)..... 842
Loss, Preventable, in Agriculture..... 426
Luminous Organs, The, of an Insect..... 139
Lyman, Chester S., Sketch of..... 116

McAnally, D. R..... 71
Maple-Sugar, Notes about..... 572
Marvin, D. S..... 841
Metals, The, of Ancient Chaldea (Berthelot)..... 220
Metals, the Precious, Changes in the Relative Values of (Wells)..... 170
Milk, Sewage Farm, Qualities of..... 287

PAGE
Milk, The Adulteration of (Henderson) 529
Mills, T. Wesley 266
Mineralogy, The Present Status of (Clarke) 799
Minerals, Artificial, Production of 286
Mistakes in treating Organic Refuse 714
Monkeys, The, of Dutch Guiana (Kappler) 396
Moon, The, and the Weather (Oliver) 473
Morgan, Appleton 332
Morris, Robert T., M. D 534
Morse, Professor Edward S 100, 492
Mortality, Relative, of Social Classes 428
Moth-Trap, A Floral 717
Mound-Builders, Opinions about 710

Nason, Henry Bradford, Sketch of 694
Nerve-Shock, Results of 712
Newberry, Dr. J. S 31
Newell, N. E 257
Neumann-Spallart, F. X. von 806
Notes 142, 287, 430, 575, 718, 863

Object-Teaching, Hints in 285
Oliver, John Westwood 473
Outlook, The Economic (Wells) 455
Oyster-Fattening 555
"Oyster-Fattening," The Chemistry of (Atwater) 76

Panama, Inventions at (Weld) 145
Panama, Progress at (Rogers) 447
Panama Canal, The 709
Peabody Museum, The 570
Persian Astrologers 141
Phenomena, Social, The Uniformity of (Neumann-Spallart) 806
Phonology, English (Kellogg) 387
Photographing Birds 430
Photography as an Aid to Astronomy 426
Pierson, C. W 199, 368
Plant-Growth, Another Anomaly in (Schellenberg) 122
Plants, Food and Fiber, of the North American Indians (Newberry) 31
Plants, The Earliest (Dawson) 787
Plants with Insect-Guards 573
Play, Out-Door, for School-Girls 856
Popular Miscellany 136, 281, 423, 569, 709, 856
Prudden, T. Mitchell, M. D 668
Publisher, His own 573
Purse-Web Spider, The Nest of the 862

Race, An Outcast, in the Pyrenees 546
Race and Language (Hale) 340
Railroads and Trade-Centers (Morgan) 332

PAGE

Rattle, a Snake's, The Use of 429
Receiverships, The Dangers of (Bartol) 236
Refuse, Organic, Mistakes in treating 714
Religious Thought, Evolution and (Le Conte) 311
Reptiles, Useful 859
Richards, Professor Eugene L 721
Rich Men's Duties to Themselves 571
Rocks, Genesis of "Original" 714
Rogers, Lieutenant Charles C 447
Royse, M. K 554
Ruby-Mines, The, of Burmah 716

Savagery, The, of Boyhood (Mills) 266
Schellenberg, F. B 122
Science and Practical Life (Huxley) 166
Science and Revelation (Stokes) 47
Science and the Bishops (Huxley) 352
Science in Harness (Editorial) 123
Science, The Contradictions of (Editorial) 701
Scientific Habits of Thought (Editorial) 842
Seeley, Professor, on Classical Training (Editorial) 700
Sensations, Deceptive 428
Serviss, Garrett P 53, 511
Shaler, Professor N. S 484
Siberian Lakes, The Drying up of 139
Skull, a Crystal 861
Snyder, Philip 751
Soap, Various Kinds of 713
Soil-Making, Animal Agency in (Shaler) 484
Somnambulism 286
Specialization in Science (Eimer) 26
Speir, Francis, Jr 657
Stars, The, of Autumn (Serviss) 53
Stars, The, of Winter (Serviss) 511
Stillman, W. O., M. D 114
Stokes, Professor G. G 47
Struggle, The, for Existence (Huxley) 732
Superstitions, Chinese (Fielde) 796

Table-topped Hills, The, of the Amazon 137
Taxes, English 718
Teeth, Why do our, decay so fast? 861
Think, The Time it takes to (Cattell) 488
Thompson, D. G 213
Thought and Language (Thompson) 213
Thought, Scientific Habits of (Editorial) 842
Tolstoi's Astronomy (Bowen) 267
Trees for Plantation around Houses 427
Tropical Woods, Characteristics of 138
Truth and its Pursuit (Editorial) 270
Turkish Bath, a, How to take 574

PAGE
Uniformity, The, of Social Phenomena (Neumann-Spallart)..... 806

Vaccination and Erysipelas..... 715

Warfare of Science, the, New Chapters in (White)..... 433, 596
Waters, Underground, as Social Factors (Daubrée)..... 610
Waters, Underground, The Chemistry of (Daubrée)..... 813
Weather-Prognostics (Abercromby)..... 648
Weather, The Moon and the (Oliver)..... 473
Wedding-Ring, About the (McAnally)..... 71
Weed, W. B..... 554
Weld, Stuart F..... 145
Wells, David A..... 1, 170, 289, 455, 577
Wells, David Ames, Sketch of..... 832
What can he do?..... 425
White, Andrew Dickson..... 433, 596
Whitworth, Sir Joseph, Sketch of..... 550
Why have Wages risen?..... 554
Williams, Charles..... 555
Williams, C. M..... 123
Wines, British Colonial..... 286
Women, Emotion *versus* Health in (Bissell)..... 504
Wood, Henry..... 537, 841
Woodpecker, a, Thrifty Habits of..... 711
Words, The Color of (Newell)..... 257

END OF VOL. XXXII.

HENRY HOLT & CO. have ready:

A new and revised edition of

Walker's Political Economy.

By FRANCIS A. WALKER, President Massachusetts Institute of Technology. 8vo. $2.50.

Our Native Ferns and their Allies.

By LUCIEN M. UNDERWOOD, Professor in Syracuse University. *Third edition, revised.* 12mo.

Bessey's Botanies.

BOTANY. For Students and General Readers. By CHARLES E. BESSEY, Ph. D., Professor of Botany in the University of Nebraska. With over 500 Illustrations. Large 12mo. (American Science Series, *Advanced Course.*) 611 pages. $2.75.

ESSENTIALS OF BOTANY. With 156 Illustrations. (American Science Series, *Briefer Course.*) 12mo, 292 pages. $1.35.

The Life of Thomas Hopkins Gallaudet,

FOUNDER OF DEAF-MUTE INSTRUCTION IN AMERICA. Square 12mo, with Portraits. $1.75.

"The book has the subtile charm of the best biography."—*Hartford Post.*

Uncle Sam at Home.

By HAROLD BRYDGES. 12mo, illustrated $1.25.

"There are many things in the book that all of us ought to be familiar with and are not. . . . Very bright and clever without heaviness or pretentiousness. It deserves to be read."—*N. Y. Times.*

"Exceptionally bright, diverting, and readable. Satire and fact are mingled pleasantly for the purpose of describing America and Americans from a social and political standpoint. . . . Witty, ingenious, and instructive, and underlying the infectious humor is a strong foundation of common sense. . . . Spiritedly and cleverly illustrated."—*Boston Gazette.*

FR. BECK & CO.,

Manufacturers, Importers, and Exporters of

HIGH CLASS

Wall Papers,

Request an examination of their manufactures and importations for the season of 1888, embracing

The Newest Designs and Colorings,

In English, French, German, and Japanese Goods.

REAL SILK HANGINGS READY FOR APPLYING DIRECT TO THE WALLS.

The Exhibition exceeding in variety, extent, and art development any heretofore made.

Only Manufacturers in the United States of

Lincrusta Walton

THE GREAT SANITARY

WALL COVERING.

SPECIALLY PREPARED DESIGNS AT REDUCED PRICES.

Protected by Patents. Awarded the **Gold Medal** at the International Health Exhibition, London, 1884.

Estimates and Special Designs Furnished for Entire Interior Decoration.

We Positively Guarantee all Goods of our Manufacture Free from Arsenic or any other Poisonous Matter.

Factory and Retail Salesroom: Corner Seventh Avenue and 29th St.

Branch Show-Rooms: Corner Fifth Avenue and 30th St.

MACMILLAN & CO.'S
NEW SCIENTIFIC PUBLICATIONS.

BONAR. Letters of David Ricardo to Malthus, 1810-1823. Edited by JAMES BONAR, M. A., LL. D. 8vo. $2.75.

BOWER and VINES. A Course of Practical Instruction in Botany. By F. O. BOWER, M. A., F. L. S., and SYDNEY H. VINES, M. A., F. L. S. With a Preface by W. T. T. Dyer, M. A., F. R. S. Part I., Phanerogamæ—Pteridophyta. 12mo. $1.50. Part II., Bryophyta—Thallophyta. 12mo. $1.10.

COHEN. The Owens College Course of Practical Organic Chemistry. By JULIUS B. COHEN, Ph. D., Lecturer on Chemistry, Owens College, Manchester. 16mo. 70 cents.

DE BARY. Lectures on Bacteria. By A. DE BARY, Professor in the University of Strassburg. Second Improved Edition. Translated by H. E. F. Garnsey, M. A., and Isaac B. Balfour, M. A., F. R. S. With 20 Wood-Engravings. 12mo. $1.50.

DE BARY. Comparative Morphology and Biology of the Fungi, Mycetozoa, and Bacteria. By A. DE BARY. Authorized English Translation by H. E. F. Garnsey, M. A., and Isaac B. Balfour, M. A., F. R. S. With nearly 200 Illustrations. 8vo. $5.50.

DE BARY. Comparative Anatomy of the Vegetative Organs of Phanerogams and Ferns. By A. DE BARY. Translated and Annotated by F. O. Bower, M. A., F. L. S., and D. H. Scott, M. A., Ph. D., F. L. S. With 241 Woodcuts. 8vo. $5.50.

GEIKIE. The Teaching of Geography. Suggestions Regarding Principles and Methods for the Use of Teachers. By ARCHIBALD GEIKIE, LL. D., F. R. S. 16mo. 60 cents.

GEIKIE. The Scenery of Scotland. Viewed in Connection with its Physical Geology. By ARCHIBALD GEIKIE, LL. D., F. R. S. With numerous Illustrations. 12mo. $3.50.

GOEBEL. Outlines of Classification and Special Morphology of Plants. By Dr. K. GOEBEL. Being a New Edition of Sachs's Text-Book of Botany. Book II. Authorized English Translation by H. E. F. Garnsey, M. A., and Isaac B. Balfour, M. A., F. R. S. With 407 Woodcuts. 8vo. $5.25.

HALL and KNIGHT. Higher Algebra. A Sequel to Elementary Algebra for Schools. By H. S. HALL, M. A., and S. R. Knight, B. A. 12mo, 516 pages. $1.90.

HARTLEY. A Course of Quantitative Analysis for Students. By W. H. HARTLEY, F. R. S. 16mo. $1.25.

LOCKYER. Outlines of Physiography. The Movements of the Earth. By J. NORMAN LOCKYER, F. R. S. With numerous Illustrations. 12mo. Paper covers. 60 cents.

LOCKYER. The Chemistry of the Sun. By J. NORMAN LOCKYER, F. R. S. With 134 Illustrations. 8vo. $4.50.

MACGREGOR. An Elementary Treatise on Kinematics and Dynamics. By JAMES GORDON MACGREGOR, M. A., D. Sc., Professor of Physics, Dalhousie College, Halifax, N. S. 12mo, 512 pages. $2.60.

SACHS. Lectures on the Physiology of Plants. By JULIUS VON SACHS. Translated by H. Marshall Ward, M. A., F. R. S. With 455 Woodcuts. 8vo. $8.00.

STEWART and GEE. Lessons in Elementary Practical Physics. By BALFOUR STEWART, M. A., LL. D., F. R. S., and W. W. HALDANE GEE. Vol. I.—General Physical Processes. 12mo. With Illustrations. $1.50. Vol. II.—Electricity and Magnetism. With numerous Illustrations. $2.25.

STOKES. The Burnett Lectures on Light, in Three Courses. By GEORGE GABRIEL STOKES, M. A., F. R. S. 12mo. $2.00. Contents: On the Nature of Light; On Light as a Means of Investigation; On the Beneficial Effects of Light.

*** *Macmillan & Co.'s Complete Classified Catalogue will be sent free, by mail, to any address on application.*

MACMILLAN & CO., 112 Fourth Avenue, N. Y.

JUST PUBLISHED.

PARKES'S PRACTICAL HYGIENE. Seventh edition. A Manual of Practical Hygiene, by EDMUND A. PARKES, M. D., F. R. S. Edited by F. S. B. FRANÇOIS DE CHAUMONT, M. D., F. R. S. Seventh edition, rearranged and revised. 103 Wood Engravings, 5 Lithographs, octavo. 766 pages. Cloth, $4.50.

TIDY'S MODERN CHEMISTRY. Second edition. Inorganic and Organic. A Hand-book for the Use of Students. By CHARLES MEYMOTT TIDY, F. R. C., Professor of Chemistry and Medical Jurisprudence and Public Health at London Hospital; Medical Officer of Health and Public Analyst of the City of London, etc. Second edition. Revised and enlarged. 8vo. Cloth, $5.50.

BLOXAM'S CHEMISTRY. Sixth edition. Inorganic and Organic. With Experiments. By CHARLES L. BLOXAM, Professor of Chemistry in King's College, London, and in the Department for Artillery Studies, Woolwich. Sixth edition. Revised and enlarged. With nearly 300 Engravings. 8vo. 788 pages. Cloth, $4.50; leather, $5.50.

RICHTER'S INORGANIC CHEMISTRY. Third edition. Inorganic Chemistry. A Text-book for Students. By Professor VICTOR VON RICHTER, University of Breslau. Third American, from fifth German edition. Authorized Translation by EDGAR F. SMITH, M. A., Ph. D., Professor of Chemistry, Wittenberg College, formerly in the Laboratories of the University of Pennsylvania, Member of the Chemical Societies of Berlin and Paris. With 89 Illustrations and a Colored Plate of Spectra. 12mo. Cloth, $2.00.

By same Author and Translator.

CHEMISTRY OF THE CARBON COMPOUNDS. A Complete Text and Reference Book. Illustrated. Cloth, $3.00; leather, $3.50.

*** These books may be ordered through any bookseller, or upon receipt of price, will be sent, post-paid, to any address. Catalogues of Chemical and Medical Books free upon application.

P. BLAKISTON, SON & CO., Publishers and Booksellers,
MEDICAL AND SCIENTIFIC BOOKS,
1012 Walnut Street, Philadelphia.

Origins of the English People and of the English Language.

COMPILED FROM THE BEST AND LATEST AUTHORITIES. By JEAN ROEMER, LL. D., Professor of the French Language and Literature, and Vice-President of the College of the City of New York. With Chart and Lithographic Fac-similes of Anglo-Saxon and Early French Writings. One volume, 8vo. Pages, xxiii + 658. Cloth, $3.50.

CONTENTS: I. The Early Inhabitants of Britain; II. The Roman Conquest; III. The English Conquest; IV. The Danes in England; V. The Normans in Gaul; VI. The Norman Conquest of England; VII. Growth and Decline of the Norman French in England; VIII. Specimens of Anglo-Norman French; IX. Fusion of Anglo-Norman French and Anglo-Saxon English; X. The English Language and its Vocabulary; XI. Specimens of Early English. *Appendix*—French Sources of Modern English: I. Historical Sketch of the French Language; II. Etymology; III. Specimens of Early French.

"The subject, which covers a wide range of interesting studies, involves, first of all, a critical inquiry into the origin, character, and distribution of the various races of men—Celts, Romans, Saxons, Danes, Normans—who at various epochs have found their way into the British Islands—their idioms and forms of religion, their social and political differences, their relative progress in the arts of civilized life. From the complexity of the subject, it is obvious that the knowledge we possess of all these details is not the fruit of any one man's learning, but the result of long and patient labors of many specialists in each of these branches. Availing ourselves of the latest researches of the distinguished scholars whose names we quote as our authorities in the list appended, and whose acknowledged learning and accuracy need no commendation, we here present to the student, who has not time to make a close study of their numerous works, a digest of their substance, so arranged as to be neither reduced to the skeleton of a mere abridgment, nor extended to the huge dimensions of a learned work."—*Extract from Preface.*

New York: D. APPLETON & CO., Publishers, 1, 3, & 5 Bond Street.

1888—FORTY-FOURTH YEAR—1888.

ECLECTIC MAGAZINE

OF

Foreign Literature, Science and Art.

"THE LITERATURE OF THE WORLD."

The Foreign Magazines embody the best thoughts of the ablest authors in Europe. It is the aim of the ECLECTIC MAGAZINE to select and reprint all the representative articles thus given to the world. The subscriber has then at his command, in a compact form, the best-digested work of the master-minds of the age.

The plan of the ECLECTIC includes Science, Essays, Reviews, Biographical Sketches, Historical Papers, Art Criticism, Travels, Poetry, and Short Stories.

Its Editorial Departments comprise Literary Notices, dealing with current home books. Foreign Literary Notes, Science, and Art, summarizing briefly the new discoveries and achievements in this field, and consisting of choice extracts from new books and foreign journals. The magazine will strive earnestly to meet the tastes of the most thoughtful and intelligent classes, and to present articles by the leading thinkers on both sides of the questions absorbing the attention of the religious, literary, scientific, and art world. The field of selection will be mainly the English magazines, reviews, and weeklies, to which, indeed, most of the great continental authors are contributors. The subjoined lists exhibit the principal sources whence the material is drawn, and the names of some of the leading authors whose articles may be expected to appear:

PERIODICALS.

Quarterly Review,
British Quarterly Review,
Edinburgh Review,
Westminster Review,
Contemporary Review,
Fortnightly Review,
The Nineteenth Century,
Science Miscellany,
Blackwood's Magazine,
Cornhill Magazine,
Macmillan's Magazine,
Longman's Magazine,
New Quarterly Magazine,
Temple Bar,
Belgravia,
Good Words.
London Society.
Saturday Review.
The Spectator.
The Academy,
The Athenæum,
Nature,
Knowledge,
Das Rundschau,
Revue des Deux Mondes, etc., etc.

AUTHORS.

Right Hon. W. E. Gladstone,
Alfred Tennyson,
Professor Huxley,
Professor Tyndall,
Richard A. Proctor, B.A.
J. Norman Lockyer, F.R.S.,
Dr. W. B. Carpenter,
E. B. Tylor,
Professor Max Muller,
Professor Owen,
Matthew Arnold,
Edward A. Freeman, D.C.L.,
James Anthony Froude,
Thomas Hughes,
Algernon Charles Swinburne,
William Black,
Mrs. Oliphant,
Cardinal Newman,
Cardinal Manning,
Miss Thackeray,
Thomas Hardy,
Robert Buchanan,
W. H. Mallock,
Professor Ernest Haeckel,
Henry Taine, etc., etc.

The aim of the ECLECTIC is not sensational, but to stimulate thought, and it commends itself particularly to Teachers, Scholars, Lawyers, Clergymen, and all intelligent readers who desire to keep abreast of the intellectual progress of the age.

STEEL ENGRAVINGS.

The ECLECTIC comprises each year twelve monthly numbers making two large volumes of over 1700 pages. Each of these volumes contains a fine steel engraving, which adds much to the attraction of the magazine.

TERMS: Single copies, 45 cents; one copy, one year, $5.00. Trial subscription for three months, $1.00. The ECLECTIC and any $4.00 magazine to one address, $8.00.

E. R. PELTON, Publisher,

25 BOND STREET, NEW YORK.

THE FORUM,

The New Review.

THE FORUM addresses itself to the mass of intelligent people.

It discusses subjects that concern all classes alike—in morals, in education, in government, in religion.

It is genuinely independent, both of partisan bias and counting-room influence.

It is constructive in its aim, presenting opposing views not for the purpose of exciting strife, but in order to assist the reader to form wise conclusions.

It employs the best known essayists; and it also invites to its pages men and women connected with important business and social interests who have special opportunities for information.

What Is Said of It.

"It is the most thoughtful and authoritative periodical published in the country."—*Herald, Boston, Mass.*

"Its papers are of much variety, and their treatment is masterly in the extreme."—*Palladium, New Haven, Conn.*

"In no other periodical printed in English are so many timely topics so strongly handled."—*Every Evening, Wilmington, Del.*

"For variety, richness, strength, and suggestiveness it has no peer among its contemporaries."—*Evening Journal, Ottawa, Can.*

"It has done more to bring the thinking men of the country into connection with current literature than any other publication."—*Herald, New York City.*

"The history of periodic literature does not contain another example of so sudden a rise to the very highest rank and greatest popularity."—*Argus, Albany, N. Y.*

"It touches upon a greater number of subjects of popular interest and instruction than can be found in any other periodical published in this country."—*Mail and Express, New York City.*

"Its rise and prosperity has been one of the gratifying events of the literary world. Nothing could speak better for the existence of a large and intelligent class deeply interested in the discussion of serious questions."—*Times, New York City.*

A Few of the Contributors.

President Julius H. Seelye.
Bishop F. D. Huntington.
Justice Thomas M. Cooley.
President S. C. Bartlett.
James Parton.
President F. A. P. Barnard.
Edward Everett Hale.
General Lord Wolseley.
Bishop J. L. Spalding.
President Timothy Dwight.
Professor William T. Harris.
Chancellor Howard Crosby.
Professor C. C. Everett.
President James B Angell.
Professor Alexander Winchell.
President John Bascom.
Professor St. George Mivart
President E. G. Robinson.
Professor Frederic H. Hedge.
Andrew D. White.
Professor Francis L. Patton.
Lord Bramwell.
David Dudley Field.
Professor William G. Sumner.
Major J. W. Powell.
Professor Lester F. Ward
D. M. Craik (Miss Mulock).
Professor G. J. Romanes.
Andrew Lang.
Rev. Dr. C. A. Bartol.
Rev. Dr. Washington Gladden.
Professor A. P. Peabody
Elizabeth Stuart Phelps.
W. H. Mallock.
Professor C. A. Young.
Edward Eggleston.
Professor H. H. Boyesen.
Richard A. Proctor.
Professor Henry C. Adams.

Published monthly. 50 cents a copy. $5.00 a year.

THE FORUM PUBLISHING CO., 97 Fifth Ave., New York.

"What is a Cyclopædia?"

"WHAT is a cyclopædia? A literary work, of course, which gives information about everything. The word is derived from two Greek words, the first of which means *circle;* and the second, primarily, bringing up or educating a child. We now define the word to be *the circle of knowledge.*"

"'Gives information about everything—constitutes the whole circle of knowledge!' This means a good deal. I doubt if it can be fairly comprehended offhand, for the world has been a wonderfully busy world, and the things done—the things accomplished in an almost infinite number of directions—make up a tremendous record."

"This is true. It does mean a great deal, and one's imagination must take a wide range in order, as you say, to comprehend it all. I don't believe anybody does comprehend it without thinking it over well. Just consider! What is there not in a work that embraces the whole circle of knowledge? The very enumeration of the topics takes one's breath away. Do you want to learn about the stars, about the seas, or about the earth and all it contains? You will find the knowledge in a cyclopædia. Do you want to know what things have been discovered and what invented? Do you wish to learn of the resources, the products, the industries of the world? Its ample pages will reveal it all to you. Do you want to know what has been done in literature, or in science, or in art, or in philosophy? It is all there. If you are curious about the history of any country, or the life of any eminent man, turn to its pages and the facts are within your reach. No question comes up that the cyclopædia does not throw light upon—no question within the range of human investigation or human performance that has existed long enough to be put into books. It is a treasure-house of information so separated and arranged that any fact can be turned to instantly. You don't have to hunt for the thing you need; it is where you can put your hand upon it with no delay whatever. It is marvelous, when you think of it, that so vast an array of facts can be classified and rendered instantly accessible, but the alphabetic index system accomplishes it perfectly."

"This is all very well. Lawyers, doctors, and clergymen find it, no doubt, indispensable, but—"

"There are no exceptions whatever, except the exceptions of sheer stupidity. Your man who is not only ignorant, but who wishes to remain ignorant, has no use for a cyclopædia. For everybody else it is not merely useful, but absolutely necessary. Every intelligent person, caring at all for what has been accomplished in the world, who needs information in the way of his business, or who desires information on the various subjects that agitate the public mind, needs a cyclopædia as much as he needs his morning newspaper. In fact, it is a supplement to the morning paper. A man's newspaper informs him of the events that took place yesterday, but, in order to appreciate the significance of those events, in order to understand them fully and accurately, it is often necessary to consult some fact in history, geography, science, or other theme, and a cyclopædia, if at hand, is ready to give the information required. There is no man whose calling is so lowly that he can not find a cyclopædia useful. The judge wants it, the lawyer wants it, the doctor wants it, the banker wants it, the man of letters wants it, the artist wants it, the teacher wants it, the merchant wants it, the manufacturer wants it, the farmer wants it, the artisan wants it, the railroad official wants it, the telegraph and telephone operator wants it, the tradesman wants it—everybody, in short, needs it, male and female—excepting, perhaps, the millionaire. If a man is a millionaire, he can have his library of ten thousand volumes, and employ a dozen secretaries to hunt up his facts, if he wants any facts. The rest of us who can not employ a dozen secretaries, and do not own ten thousand volumes, need a cyclopædia every day of our lives."

"Your ideas are comprehensive, for you make the whole people your constituency. In no other country could this be possible."

"No doubt, and this is due to the superior intelligence of the people, and this superior intelligence is the result of our public-school system. The public schools implant a desire for knowledge in the minds of the lowliest, and, once

experienced, this desire makes men eager to go to the bottom of things, and there is no swifter or surer way of getting to the bottom of things than by going to a cyclopædia.

"And then, when once a man has formed the habit of consulting a cyclopædia, he is lost if he can not have access to one. The habit grows with our knowledge, strengthens with our intelligence, and becomes a very part of ourselves. Who would think of doing without a dictionary? Yet a hundred years ago dictionaries were just coming into general use. People have lived without chimneys, without window-glass, without carpets, without forks, and without dictionaries, but civilized communities do not now dream of doing without them. And so it is fast becoming with cyclopædias. Use becomes second nature. Once in a family, and the members of the family in the habit of consulting it, they could as soon do without any other of the conveniences of civilization as without a cyclopædia.

"Think of its influence for good where there are young people—and what roof does not cover young people? The very word involves the idea of educating the child, as I have already said. The wisest provision a father can make for his boys and girls is to purchase a cyclopædia. Once encouraged to consult it, young people will soon fall into the way of going to its pages in order to gratify their curiosity on many themes, and is it not easy to see what an intellectual stimulus this must be? A cyclopædia not only opens the doors to all knowledge, but often creates the desire for knowledge. As an educator in the family, therefore, too much can not be said for it. It is not only of great value intellectually but morally. A man's sons and daughters are not only sure to become more intelligent if taught to study a cyclopædia, but the taste thus formed will save many a lad from dissolute habits, and many a young woman from becoming a frivolous gossip."

"But there are cyclopædias and cyclopædias."

"True enough. There are cyclopædias too meager to serve the end in view, and cyclopædias too ponderous and technical for popular instruction. I have in mind THE AMERICAN CYCLOPÆDIA, which seems to me to occupy the golden mean. A cyclopædia is insufficient that excludes all biographies of living men and stops in its survey of general subjects a generation ago, as is the case with most foreign cyclopædias; and a cyclopædia is tantalizing that merely outlines information and leaves the reader only half informed. The articles in THE AMERICAN CYCLOPÆDIA are concise and direct; they contain nothing unnecessary, but everything necessary to the understanding of the subject; they bring information down to the latest time; they are written by men who have given their lives to the study of the various themes; they are clothed in clear and simple language; they are not burdened by obscure and technical terms, and are not only accurate but eminently interesting. The editors strove by every means within their power to make them the models of what cyclopædia articles should be.

"THE AMERICAN CYCLOPÆDIA is pre-eminently the cyclopædia for the American people because no other work of the kind is so full of American subjects. It is pre-eminently the work for the American reader, because it was prepared with the tastes and the intellectual needs of Americans fully in view. It is the great national cyclopædia written by Americans for Americans.

"'What is a cyclopædia?' you ask. A universal library, a compendium of the whole range of knowledge, a narrative of all that has been done, a revelation of all that has been discovered, a panorama of the world's history, the substance of ten thousand volumes in one shelf-ful of volumes, a single work that does as much, perhaps, for the spread of knowledge and the growth of intelligence as our system of public education.

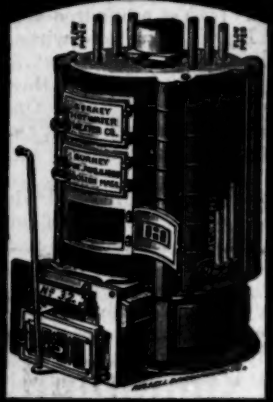
"This is what a cyclopædia is, and THE AMERICAN CYCLOPÆDIA, edited by George Ripley and Charles A. Dana, and published by D. Appleton & Co., is the work that fulfills the great purpose of a cyclopædia better than any other."

For specimen pages and terms, address

D. APPLETON & CO., Publishers,

1, 3, & 5 BOND STREET, NEW YORK.

GURNEY HOT WATER HEATER



FOR HEATING

Private Dwellings, Public Buildings, Offices, Conservatories, etc.

BY HOT-WATER CIRCULATION.

Saves 25% in Fuel.
Even Temperature.
Noiseless.
Non-explosive.

GENTS,—Regarding the No. 25 GURNEY HEATER which you placed in my residence last fall, I have to say that I am well pleased with its working and would not know how to get along without it. I know of no other Heater that would take its place, as I have tried two other styles, and speak from experience. Yours respectfully,
W. E. LAMPMAN, CATSKILL, N. Y., March 5, 1887.

GURNEY HOT-WATER HEATER CO., 237 FRANKLIN ST., BOSTON, MASS.

WORKS AT EAST BOSTON, MASS.

SELLING AGENCIES.—M. H. JOHNSON, 140 Centre St., N. Y., RICE & WHITACRE MFG. Co., 42 and 44 W. Monroe St., Chicago, Ill.; T. R. CHASE, 31 Edmund Place, Detroit, Mich.; WILLIAM GARDINER & Co., Portland, Oregon; J. L. FRISBIE, 526 Phila St., Covington, Ky.

It pays to do work early. *Send for new illustrated descriptive Catalogue, free.*

REASONS WHY PHYSICIANS SHOULD SUBSCRIBE FOR

The New York Medical Journal,

EDITED BY FRANK P. FOSTER, M. D.

1. BECAUSE: It is the *LEADING JOURNAL* of America, and contains more reading-matter than any other journal of its class.
2. BECAUSE: It is the exponent of the most advanced scientific medical thought.
3. BECAUSE: Its contributors are among the most learned medical men of this country.
4. BECAUSE: Its "Original Articles" are the results of scientific observation and research, and are of infinite practical value to the general practitioner.
5. BECAUSE: The "Reports on the Progress of Medicine," which are published from time to time, contain the most recent discoveries in the various departments of medicine, and are written by practitioners especially qualified for the purpose.
6. BECAUSE: The column devoted in each number to "Therapeutical Notes" contains a *résumé* of the practical application of the most recent therapeutic novelties.
7. BECAUSE: The Society Proceedings, of which each number contains one or more, are reports of the practical experience of prominent physicians who thus give to the profession the results of certain modes of treatment in given cases.
8. BECAUSE: The Editorial Columns are controlled only by the desire to promote the welfare, honor, and advancement of the science of medicine, as viewed from a standpoint looking to the best interests of the profession.
9. BECAUSE: Nothing is admitted to its columns that has not some bearing on medicine, or is not possessed of some practical value.
10. BECAUSE: It is published solely in the interests of medicine, and for the upholding of the elevated position occupied by the profession in America.

Subscription Price, $5.00 per Annum. **Volumes begin in January and July.**

Published by D. APPLETON & CO., 1, 3, & 5 Bond Street, New York.

KNICKERBOCKER

SUBSCRIPTION AGENCY,

132 Nassau Street,

New York.

Special advantages to LYCEUMS, ASSOCIATIONS, CLUBS, and INDIVIDUALS, to secure MAGAZINES and NEWSPAPERS at reduced prices. Subscriptions may begin at any time.

Back numbers and bound volumes of any magazine supplied. Send for catalogue.

FIFTY CENTS A YEAR.

DORCAS

An Illustrated Monthly of

WOMAN'S HANDIWORK.

Contains PLAIN directions for making useful and decorative articles.

Every Pattern is tested by an expert.

A recognized authority on Crochet-Work, Knitting, Netting, Embroidery, Art Needlework, etc., etc.

Its suggestions regarding both old and new industries for women are invaluable, and aid women to become self-supporting.

NOVELTIES of the NEW YORK, PARIS, and BERLIN shops are illustrated promptly.

Send 25 cents for a 6 Months' Trial.

Address The DORCAS MAGAZINE, 239 Broadway, New York

SEEDS GIVEN AWAY! A package of Mixed Flower Seeds (500 kinds), with PARK'S FLORAL GUIDE, all for 2 stamps. Every flower lover delighted. Tell all your friends. G. W. PARK, Fannettsburg, Pa. Send at once. This notice will not appear again.

APPLETONS'

Dictionary of New York

AND ITS VICINITY.

With Maps. - - - Paper, 30 cents.

The WILSON Patent Adjustable Chair,

With thirty changes of positions.

Parlor, Library, Invalid Chair, Child's Crib, Bed, or Lounge, combining beauty, lightness, strength, simplicity, and comfort. *Everything to an exact science.* Orders by mail promptly attended to. Goods shipped to any address, C. O. D. Send for Illustrated Circular. Address

WILSON BROTHERS,

SOLE PROPRIETORS AND MANUFACTURERS,

823 Broadway, New York.

"Nothing better has appeared for the purpose for which these publications are intended."—Chicago Inter Ocean.

"The simplicity of method is admirable. It justifies the title."—Norristown Herald.

German Simplified.

Spanish Simplified.

"Any one desirous of obtaining a practical knowledge of the Spanish language in a short space of time will find this series of real value."—San Francisco Chronicle.

GERMAN SIMPLIFIED.—For self-instruction, complete in 12 numbers (with keys), at 10 cents each. School edition bound in cloth (without keys), $1.25.

SPANISH SIMPLIFIED.—42 numbers (with keys), 10 cents each. No. 6 was published February 1, 1888; a new number appears on the first of every month, until completed.

Both works are for sale by all booksellers: sent post-paid on receipt of price, by Prof. A. KNOFLACH, 160 Nassau Street, New York. Prospectus mailed free.

APPLETONS'

Hand-Book of American Winter Resorts,

FOR TOURISTS AND INVALIDS.

With Maps, Illustrations, and Table of Railway Fares.

New edition, revised to the present day.

Large 12mo. Paper cover, 50 cents.

NEW YORK: D. APPLETON & CO., PUBLISHERS,

1, 3, & 5 BOND STREET.

BOOK CHAT.

Novel, Bright, and Original.

It gives each month a classified list of *every article* on *every subject* in the magazines of the world—American, English, French, German, Spanish, and Italian. This will be found of incalculable value to persons interested *in any special course of reading or studies*, or those merely wishing to keep up to the times on questions of the day.

In a half-dozen lines is given an outline of each book of the month, showing something of its plot, object, etc., telling what a book is about rather than criticising it.

Fifteen Bright Departments.

New Books,	Magazine Leaders,
Gossip about Authors,	Some Notable Books,
Selected Current Readings,	With the Poets,
Coming Books,	New Serials,
Magazine Briefs,	Open Questions,
Without Comment,	Novel Editorials,
Classified Lists,	Fugitive Essays

Latest French, German, Spanish, and Italian Books.

PRESS COMMENTS.

"Comprehensive and well edited."—*N. Y. Graphic.*

"A perfect gem in its way."—*Troy Budget.*

"The field which this sprightly monthly covers is one that heretofore has been left unoccupied. While it gossips it is never trivial, but in a brief paragraph or a few words oftimes conveys as much practical meaning as the longer criticism of its older literary contemporaries."—*Brooklyn Magazine.*

"Represents an herculean amount of labor, and it is labor so well directed that every stroke is sure, every touch a happy one. Its editorials are keen and novel."—*Boston Traveller.*

$1.00 per year; single numbers, 10 cts.

BRENTANO'S,

5 Union Square, New York.

F·W·DEVOE·&·CO.

ESTABLISHED 1852.

OFFICES: COR. FULTON & WILLIAM STS.

NEW YORK.

ARTISTS' MATERIALS.

SKETCHING OUTFITS OF ALL KINDS

TUBE COLORS · WATER COLORS · CRAYONS

DRAWING PAPER · CANVAS · BRUSHES · OILS & MEDIUMS ·

MATHEMATICAL INSTRUMENTS

HOUSE PAINTERS' COLORS

FRESCO COLORS · FINE VARNISHES

Correspondence invited · Catalogues of our different departments to responsible parties.

COFFIN·DEVOE & Co·176 RANDOLPH ST·CHICAGO

JOSEPH GILLOTT'S STEEL PENS.

Sold by all Dealers throughout the World!

Gold Medal, Paris Exposition, 1878.

For Fine Writing, No. 1, 303, *and Ladies,* **170. For Broad Writing, 294, 389,** *and stub point,* **849. For General Writing, 332, 404, 390,** *and Falcon,* **878, 908.** *Other styles to suit all hands.*

☞ *Sample Cards, Price-lists, etc., furnished on application.*

JOSEPH GILLOTT & SONS, 91 John St., New York. HENRY HOE, Sole Agent.

THE NEW MODEL, OUR LATEST and BEST MOWER.

For Simplicity and durability, and quality of work, it is unequalled, while for Lightness of draft it excels by a large percentage any other Lawn Mower made. Send for circular and price-list.

CHADBORN & COLDWELL MANUF'G CO., NEWBURGH, N. Y.

Wealth and Progress:

A CRITICAL EXAMINATION OF THE LABOR PROBLEM. The Natural Basis for Industrial Reform, or How to Increase Wages without Reducing Profits or Lowering Rents: the Economic Philosophy of the Eight-Hour Movement. By GEORGE GUNTON. 12mo, cloth. Price, $1.25.

D. APPLETON & CO., PUBLISHERS.

Henry George *vs.* Henry George.

A REVIEW.

By R. C. RUTHERFORD.

12mo, paper cover. Price, 50 cents.

D. APPLETON & CO., Publishers, 1, 3, & 5 Bond St.

Gate City Stone Filter Co.,

46 MURRAY ST., NEW YORK.

Fine China and Gray Stone Ware Jars to hold the water. A NATURAL STONE for a FILTERING MEDIUM. Fitted with separate Patent Ice-Chambers to cool the water.

☞ As easily cleaned as a water-pitcher.

No metal or other objectionable material used in the construction of this Filter.

All water is filled with impurities during the rainy season with washings from the earth and the air. This Filter will ABSOLUTELY CLEAN IT.

CHEAPEST, MOST ORNAMENTAL, and BEST Filter for family and office use on the market.

Address as above for descriptive Price-List. Mention this Journal.

BRADSTREET'S

A JOURNAL OF

TRADE, FINANCE, and PUBLIC ECONOMY.

ISSUED EVERY SATURDAY

BY THE BRADSTREET COMPANY, 279 BROADWAY, N. Y.

Subscription price, $5 a year. Single copies, 10 cents.

NO OTHER NEWSPAPER

Treating Specially or Casually of Business and Economic Subjects furnishes

Telegraphed reports of the condition of general trade at all the larger cities.
Telegraphic reports of the principal domestic money markets.
Loan and domestic exchange rates at financial centers, with comparisons.
Bank clearings for the week at 38 cities down to day of going to press.
Railway earnings monthly, with returns classified and compared with totals for four years.
Specially telegraphed reports of exports of wheat, flour, and Indian corn, for the week ending with day of going to press.
Complete and accurate reports of mercantile failures weekly, monthly, and yearly.
Early and comprehensive summaries of important decisions of the courts having a bearing on commercial and industrial interests.

A New and Charming Book for Scientific Amateurs, Beautifully Illustrated.—Just Ready.

Home Experiments in Science.

FOR OLD AND YOUNG. A Repertory of Simple Experiments with Home-made Apparatus. Including Mechanics, General and Molecular Physics, Soap-Bubbles and Capillarity; with Detailed Instructions in the Necessary Mechanical Operations, and Illustrations of the Experiments and Apparatus. By T. O'CONOR SLOANE, E. M., A. M., PH. D. Illustrated by 97 Engravings. In one vol. 12mo, 260 pages, handsomely bound in scarlet cloth, gilt. Price, $1.50. *By mail, free of postage, to any address in the world.*

CONTENTS: CHAP. I. Experimental Science; II. Mechanical Operations; III. Experiments in Mechanics; IV. Experiments in Gravitation, Hydraulics, and Pneumatics; V. Atoms and Molecules; VI. Experiments in Molecular Physics; VII. Experiments with Soap-Bubbles; VIII. Experiments in Heat, Sound, and Light; IX. Lecturing; Index.

☞ *An illustrated circular, 4 pages 4to, giving the full Table of Contents of this volume, will be sent free of postage to any one in any part of the world who will apply by letter.*

☞ *The above or any of our books sent by mail, free of postage, at the publication price to any address in the world.*

☞ *Our New Revised Descriptive Catalogue of Practical and Scientific Books, 80 pages 8vo, and our other Catalogues and Circulars, the whole covering all the branches of science applied to the arts, sent free, and free of postage, to any one in any part of the world who will furnish his address.*

HENRY CAREY BAIRD & CO., Industrial Publishers, Booksellers, and Importers,
810 Walnut St., Philadelphia, Pa., U. S. A.

APPLETONS'

STATISTICAL ATLAS

OF THE

UNITED STATES

CONSISTING OF

Maps of the United States (in two parts), a Separate County Map of each State, all printed in Colors, Railway Maps,

AND

FULL DESCRIPTIVE TEXT,

Historical, Descriptive, Political, and Industrial, giving an Outline of the History of the Union and of each State, describing Geographical Features, showing the Natural Resources and Extent and Character of the Industries of each State, giving Statistics of Population, of Commerce, and of Agricultural Products, with information on various other subjects.

Imperial 8vo, cloth. Price, $1.50.

D. APPLETON & CO., Publishers, New York.

REASONS WHY PHYSICIANS SHOULD SUBSCRIBE FOR THE

New York Medical Journal,

EDITED BY FRANK P. FOSTER, M. D.,

Published by D. APPLETON & CO., New York.

BECAUSE: It is the *LEADING JOURNAL* of America and contains more reading-matter than any other journal of its class.

BECAUSE: It is the exponent of the most advanced scientific medical thought.

BECAUSE: Its contributors are among the most learned medical men of this country.

BECAUSE: Its "Original Articles" are the results of scientific observation and research, and are of infinite practical value to the general practitioner.

BECAUSE: The "Reports on the Progress of Medicine," which are published from time to time, contain the most recent discoveries in the various departments of medicine, and are written by practitioners especially qualified for the purpose.

BECAUSE. The column devoted in each number to "Therapeutical Notes" contains a *résumé* of the practical application of the most recent therapeutic novelties.

BECAUSE: The Society Proceedings, of which each number contains one or more, are reports of the practical experience of prominent physicians who thus give to the profession the results of certain modes of treatment in given cases.

BECAUSE: The Editorial Columns are controlled only by the desire to promote the welfare, honor, and advancement of the science of medicine, as viewed from a standpoint looking to the best interests of the profession.

BECAUSE: Nothing is admitted to its columns that has not some bearing on medicine, or is not possessed of some practical value.

BECAUSE: It is published solely in the interests of medicine, and for the upholding of the elevated position occupied by the profession of America.

The volumes begin with January and July of each year. Subscriptions can be arranged to begin with the volume.

Subscription Price, $5.00 *per Annum.*

The Popular Science Monthly and the New York Medical Journal to the same address, $9.00 per Annum (full price, $10.00).

New York: D. APPLETON & CO., 1, 3, & 5 Bond Street.

ALBANY PERFORATED WRAPPING PAPER CO.,

Manufacturers of Writing, Wrapping, Toilet, "Anti-Rust," and Medicated Papers.

Principal Office,
ALBANY, N. Y.

Branch Offices,
NEW YORK,
CHICAGO,
BOSTON.

LONDON,
British Patent Perforated Paper Co. (Limited),
Banner Street,
St. Lukes, E. C.

MANILLA, WHITE, and COLORED
Wrapping Papers
In Rolls,
All Sizes and Weights.

ANTI-RUST
Wrapping Paper,
For BRIGHT GOODS.
Perfect Protection against Injury from Dampness.

PRICE REDUCED
50 °/₀
This Fixture Heavily Plated
— AND —
Four 1,000-SHEET Rolls,
BEST STANDARD BRAND
(NOT MEDICATED),
DELIVERED FREE
Anywhere in the United States on receipt of
ONE DOLLAR.

OUR MEDICATED PAPER

For sufferers from Hæmorrhoids has proved a most successful vehicle for emollient and astringent remedies, affording a means of securing for chronic cases that regular, persistent treatment, without which the advice and remedies of the ablest physicians fail to relieve.

This paper, heavily charged with an ointment approved by the profession, offers a method of treatment free from the inconvenience and annoyance attending the use of other remedies. The itching type of the disease quickly yields to its influence.

We submit a few extracts from the many letters we receive as to the value of our Medicated Paper. The originals may be seen at our office:

31 SOMERSET ST., BOSTON, MASS.

A. P. W. PAPER CO.

GENTLEMEN:—Your Medicated Toilet Paper is useful in the treatment of Anal diseases, allaying to a great extent the intense itching, is a remedy easily applied, and a trial is convincing of its merits.

F. M. JOHNSON, M. D., *July* 1, 1885.

NEW HAVEN, *Feb.* 1, 1886.

It is a decided pleasure to find an advertised article possessing real merit. I inclose $1 for a further supply.

NEW YORK, *April* 5, 1886.

FROM A PHYSICIAN.—I am much pleased with your sample of Medicated Paper. Please send me eight packages and pocket case for $1 inclosed.

NEWBURG, *May* 17, 1886.

My physician recommends your Medicated Paper, and I inclose $1 for eight packets with pocket case.

NEW YORK, *April*, 1885.

Your Medicated Paper has been used with most gratifying result. It is a splendid remedy and has my unqualified indorsement. Please send two 1,000-sheet rolls.

LISBON, D. T., *April* 30, 1886.

Your Medicated Paper is a bonanza in my family; has relieved two cases of long standing. I inclose $1 for two rolls.

NORRISTOWN, PA., *Dec.* 15, 1886.

A. P. W. PAPER CO.

GENTLEMEN:—Having recommended your Medicated Paper to a number of my patients suffering with Hæmorrhoids, I find it of great benefit in preventing the intense itching, and in some cases has made a permanent cure.

NEW HARTFORD, IOWA, *Aug.* 11, 1887.

We can not do without your Medicated Paper. Send $2 worth at once.

FITTSBURG, PA., *Aug.* 7, 1887.

I inclose Postal-Note for four rolls Medicated Paper, the best remedy we have ever found.

CUSTON, IOWA, *Aug.* 3, 1887.

I have tried your Medicated Paper, find it good, and inclose one dollar for further supply.

ARPCLE, FINAL CO., ARIZONA, *June* 14, 1887.

Please send me ten rolls of your most excellent Medicated Paper.

GRETNA, IOWA, *Aug.* 1, 1887.

I have suffered for years until relieved by your Medicated Paper. Inclosed find $2 for more of it.

UNIVERSITY, MISS., *July* 8, 1887.

I have had great benefit from your Medicated Paper, and inclose Postal-Note for another roll.

SEDALIA, MO., *July* 15, 1887.

I inclose $1, for which please send me pocket packages of your most excellent Medicated Paper.

DMIOPOLIE, ALA., *July* 29, 1887.

I find your Medicated Paper better than any I have ever used. Send me one dollar's worth in small packages, as I carry it with me.

DENVER, COL., *April* 19, 1887.

I have found your Medicated Paper superior to any I ever saw, and inclose $1 for more of it.

Pocket Packet, $0.10; Price per Roll of 1,000 Sheets securely wrapped in Tin-Foil, $0.50; Eight Packets and Neat Pocket Case, $1.00; Two 1,000-Sheet Rolls, and Nickel Fixture, $1.30.

Delivered Free, anywhere in the United States, on receipt of price. Address

ALBANY PERFORATED WRAPPING PAPER CO., ALBANY, N. Y.

BUFFALO LITHIA WATER

NATURE'S NERVE TONIC.

Nature's Specific for Bright's Disease

A Powerful Nervous Tonic. It is a wonderful restorative in **Nervous** exhaustion, neuralgia, and affections generally of the nervous system. Both a remedy for and preventive of **Mental** and **Physical Exhaustion** from **Overwork** or Bright's Disease, Gout, Rheumatic Gout, Rheumatism, Acid Dyspepsia, Malarial Poisoning, &c. It is par excellence a remedy. Endorsed by medical men of the highest distinction.

Water in Cases of one dozen half gallon bottles, $5 per case, at the Springs.

THOS. F. GOODE, Proprietor, BUFFALO LITHIA SPRINGS, Va.

A Naturalist's Rambles about Home.

By Dr. CHARLES C. ABBOTT.

A NEW EDITION, REVISED, AND ISSUED IN A NEW STYLE.

12mo, cloth. - - - - - - - - - Price, $1.50.

"Ever since the days of Izaak Walton, books like this have been popular, but there never was before a time when they found so many intelligent readers as they do at present."—*Boston Transcript.*

D. APPLETON & CO., Publishers, New York.

THE

STEAM-ENGINE

By GEORGE C. V. HOLMES.

New volume of "Text-Books of Science."

With numerous Illustrations.

16mo, cloth. - - Price, $2.25.

"The progress of technical education during the last few years has rendered necessary the production of an elementary text-book on the steam-engine, containing information upon branches of the subject which have hitherto received but scant notice in works of this nature."—*From the Preface.*

D. APPLETON & CO., Publishers, New York.

APPLETONS'

General Guide to the United States and Canada.

With numerous Maps and Illustrations.

REVISED FOR THE SEASON OF 1887.

In three separate forms:

ONE VOLUME COMPLETE, pocket-book form, roan. Price, $2.50.

NEW ENGLAND AND MIDDLE STATES AND CANADA, one volume, cloth. Price, $1.25.

SOUTHERN AND WESTERN STATES, one volume, cloth. Price, $1.25.

D. APPLETON & CO., Publishers, New York.

THE CALIGRAPH WRITING MACHINE

Price, $85.00

It Stands at the Head!

20,000 in daily use.

For printed matter, etc., address

—:THE MOST:—

Practical, Durable and Rapid

WRITING MACHINE

FOR THE

Office, Library, and Family.

THE AMERICAN WRITING MACHINE CO.,

New York Branch, 237 Broadway. HARTFORD, CONN.

Equitable MORTGAGE COMPANY.

Capital Subscribed $2,000,000
Capital Paid in (Cash) . . . 1,000,000

6 PER CENT DEBENTURES and GUARANTEED FARM MORTGAGES. Interest payable semi-annually at any of our offices. Our mortgages are upon improved FARMS ONLY. We loan no money on the unduly stimulated property of the towns and cities. Also

MUNICIPAL BONDS.

OFFICES:

NEW YORK, 208 B'way. | PHILADELPHIA, cor. Chestnut and 4th Sts.
BOSTON, 117 Devonshire St. | LONDON, England.

SEND FOR PAMPHLET.

ESTABLISHED 1801.

BARRY'S TRICOPHEROUS

FOR THE HAIR

The Oldest and the Best.

The oldest and the best in the world. The hair dressed daily with this unrivaled preparation will never decay, or fall out, or lose its lustre, or show any signs of disease or decline.

THE BEST

INVESTMENT

for the Family, the School, or the Professional or Public Library, is a copy of the latest issue of Webster's Unabridged.

Besides many other valuable features, it contains

A Dictionary
of 118,000 Words, 3000 Engravings,
A Gazetteer of the World
locating and describing 25,000 Places,
A Biographical Dictionary
of nearly 10,000 Noted Persons,
All in One Book.

3000 more Words and nearly 2000 more Illustrations than any other American Dictionary.
Sold by all Booksellers. Pamphlet free.
G. & C. MERRIAM & CO., Pub'rs, Springfield, Mass.

MADE WITH BOILING WATER.

EPPS'S

GRATEFUL—COMFORTING.

COCOA

MADE WITH BOILING MILK.

AND NOT WEAR OUT

SOLD by Jewelers. By mail, 25c. Circulars free.
J. S. BIRCH & Co., 184 Lewis St., N. Y.

ESTERBROOK'S STEEL PENS.

Leading Nos. 14, 048, 128, 130, 135, 333, 161.
FOR SALE BY ALL STATIONERS.
THE ESTERBROOK STEEL PEN CO.,
Works, Camden, N. J. 26 John St., New York.
R. ESTERBROOK, Pres. A. C. WOOD, Treas. F. WOOD, Sec.

He won't be happy till he gets it!

RELIEVES HEADACHE.

REMOVES BILIOUSNESS.

NEVER TRAVEL

WITHOUT

A bountiful supply of

TARRANT'S

Effervescent Seltzer Aperient.

The most agreeable Aperient known to Medical Science.

PRESCRIBED BY EMINENT PHYSICIANS FOR MORE THAN 40 YEARS.

It is put up in bottles in powder form, producing, when dissolved in water, a delightful effervescent draught.

IT CURES

Sea-Sickness,

Constipation,

Sick Headache,

Heartburn.

"U. S. NAVY YARD, PORTSMOUTH, N. H.,
"COMMANDANT'S OFFICE.

"GENTLEMEN:

"It gives me pleasure to express my perfect satisfaction with the wholesome effects of your SELTZER APERIENT. I have had occasion to use it in almost every part of the world. Yours sincerely,

"OSCAR G. SAWYER, *Secretary.*

"Messrs. TARRANT & Co., New York."

A Prominent Divine of Charleston writes:

"I very willingly bear testimony to the value of TARRANT'S SELTZER APERIENT. It has been in use in my family many years. I never travel without it, and have found it of special value as a preventive or corrective of *sea-sickness*. I have been enabled by its use to relieve many who were suffering from this most distressing malady, and who have found other remedies ineffective.

"CHARLESTON, S. C., *December* 3, 1883."

IT CURES

Sour Stomach,

Indigestion,

Dyspepsia,

Biliousness.

It removes all ill effects arising from irregular meals, bad water, poor cooking, and the distressing symptoms proceeding from imperfect digestion or disordered stomach.

FOR TRAVELERS BY SEA OR LAND, TARRANT'S EFFERVESCENT SELTZER APERIENT IS AN INVALUABLE COMPANION.

"No traveler of experience thinks his outfit complete without it."

MANUFACTURED ONLY BY

TARRANT & CO.,

NEW YORK.

Sold by Druggists generally throughout the United States, and

NEWBERRY & SON,

St. Paul's Churchyard, London.

AIDS DIGESTION.

CURES CONSTIPATION.

VOL. XXXII.] ESTABLISHED BY EDWARD L. YOUMANS. [No. 6.

THE

POPULAR SCIENCE MONTHLY.

APRIL, 1888.

EDITED BY W. J. YOUMANS.

CONTENTS.

		PAGE
I.	College Athletics and Physical Development. By Professor Eugene L. Richards. (Illustrated.)	721
II.	The Struggle for Existence. By Professor T. H. Huxley	739
III.	Forms and Failures of the Law. By Philip Snyder	751
IV.	Hypnotism in Disease and Crime. By A. Binet and C. Féré	763
V.	Californian Dry-Winter Flowers. By Prof. Byron D. Halsted	770
VI.	The Family-Life of Fishes. By Karl Hiegnicke. (Illustrated.)	777
VII.	A Paper of Candy. By William Sloane Kennedy	789
VIII.	The Earliest Plants. By Sir William Dawson. (Illustrated.)	797
IX.	Chinese Superstitions. By Adèle M. Fielde	796
X.	The Present Status of Mineralogy. By Prof. F. W. Clarke	799
XI.	Uniformity of Social Phenomena. By F. Neumann-Spallart	806
XII.	The Chemistry of Underground Waters. By Prof. G. A. Daubrée	813
XIII.	The Cause of Character	821
XIV.	Sketch of David Ames Wells. (With Portrait.)	832
XV.	Correspondence	841
XVI.	Editor's Table: Scientific Habits of Thought.—Death of Professor Gray, etc.	842
XVII.	Literary Notices	848
XVIII.	Popular Miscellany	856
XIX.	Notes	862

NEW YORK:
D. APPLETON AND COMPANY,
1, 3, AND 5 BOND STREET.

SINGLE NUMBER, 50 CENTS. YEARLY SUBSCRIPTION, $5.00.

COPYRIGHT, 1888, BY D. APPLETON AND CO.

Entered at the Post-Office at New York, and admitted for transmission through the mails at second-class rates.

HAVE YOU CATARRH?

IT CAN BE CURED.

Whether you believe it or not, send for a pamphlet describing

DRS. STARKEY & PALEN'S TREATMENT BY INHALATION.

NOT A DRUG.

Catarrh. There is no other disease that comes so near being a universal one in this country as Catarrh. The victims of it are very ignorant of its cause, nature, or remedy. A little enlightenment on the subject will prove a blessing to the many sufferers from it. For this purpose it is needful to know something of the anatomy and physiology of the mucous membrane, for this is the seat of the disease.

The most familiar example of the mucous membrane is the inside of the lips, cheeks, throat, and nostrils. In these situations it may be quite closely examined by any one. It is seen to be smooth, shining, of a pink color, and is moist. From these visible locations the membrane extends through the whole of the respiratory or breathing organs, and of the digestive organs; and it lines every organ which has an opening to the outside world. In its anatomy it bears a strong analogy to the skin. In some lower order of animals either of these membranes may be made to do the office of the other. The animal may be turned wrong side out, in which case the skin and lining of the stomach have changed places, and the animal continues to live.

One office of this membrane is to exude from its myriads of minute glands a bland, transparent, unctuous fluid. This is called mucus, and it keeps the membrane in a condition to perform its many other functions properly. There are many causes operating to set up congestion, swelling, and inflammation in this membrane. When it becomes inflamed the quality and quantity of the normal mucus are immediately changed. A good illustration of this is an acute attack of influenza, "cold in the head," which needs no description. There are many stages and degrees of this affection, and all are properly named CATARRH.

It may cause severe pain in the head, face, ears, throat, chest, and elsewhere. The effects are very annoying to its victim, and at times the sufferer becomes disgustingly offensive to his companions. One characteristic of this disease is the obstinacy with which it resists the best directed and even successful treatment. The number of M. D.'s who can boast of having CURED a single case of Catarrh is humiliatingly small. Hence have sprung up a little army of "Catarrh Specialists." Sometimes these succeed in partially drying up the profuse discharge, and call it a cure. But the disease is a strictly constitutional one, and hence can not be cured by the application of merely local treatment.

The Compound Oxygen is the only known remedial agent that will cure Catarrh with commendable promptness. There are two features of the cure of Catarrh by this treatment which should commend it to the enlightened attention of its victims: First—The whole constitutional health is being improved and established at the same time. Second—The system being thus put into a state of integrity, it remains there, and the cure is therefore permanent.

"ALMA, NEB., *April* 6, 1887.

"Six months ago to-day, I commenced the use of a Home Treatment of Compound Oxygen, which, as I wrote you in April, I expected to take at least one year to get well, if ever. I am about as well now as a man of sixty-two years of age could be expected to be, after suffering for twenty years. *I am entirely cured of Catarrh; pain in spine; bowels regular; appetite improved.* Before using it I seldom ate more than one meal a day, and never any breakfast for some years, and *sleep was out of the question except about one night in three for the last eighteen years. Since inhaling, I have not lost a half-dozen nights' sleep in six months, and none in five and a half months.* Hon. H. C. GRIFFITH."

It will be interesting to the afflicted to peruse the new *brochure*, a book of 200 pages, full of the account of Drs. Starkey & Palen's Compound Oxygen, and the testimony of wonderful cases in Consumption, Asthma, Bronchitis, Dyspepsia, Catarrh, Hay-Fever, Headache, Debility, Rheumatism, Neuralgia, and all Chronic and Nervous Disorders cured or helped by this treatment. It will be sent free by mail to all who will address DRS. STARKEY & PALEN, No. 1529 Arch Street, Philadelphia, Penna.; 331 Montgomery Street, San Francisco, Cal.; 58 Church Street, Toronto, Canada.

WILLIAM KNABE & CO.'S

GRAND, SQUARE, AND

UPRIGHT PIANO-FORTES.

PIANO FACTORY,

BALTIMORE, MD.

These Instruments have been before the public for nearly fifty years, and upon their excellence alone have attained an *unpurchased pre-eminence*, which establishes them as unequaled in Tone, Touch, Workmanship, and Durability. Every Piano fully warranted for five years. Prices greatly reduced. Illustrated Catalogues and Price-Lists promptly furnished on application.

WILLIAM KNABE & CO.,

112 Fifth Avenue, New York. 204 & 206 W. Baltimore Street, Baltimore.

817 Market Space, Pennsylvania Avenue, Washington, D. C.

We give to every purchaser of the Remington Typewriter the privilege of returning it unbroken at any time within thirty days, C. O. D., for full price paid, if not ABSOLUTELY SATISFACTORY IN EVERY RESPECT.

REMINGTON

STANDARD TYPEWRITER.

We guarantee the Superiority of our Machines.

"Sales larger than of all other writing machines combined."

Our stock of Typewriter supplies is the largest and finest in the world.

Illustrated pamphlet and sample-book of our fine linen papers free upon application.

Note.—*Our unqualified challenge* for a test of all Writing Machines *remains unaccepted.* Send for copy if interested.

WYCKOFF, SEAMANS & BENEDICT,

327 Broadway, New York.

GOLD MEDAL, PARIS, 1878.

BAKER'S

Vanilla Chocolate,

Like all our chocolates, is prepared with the greatest care, and consists of a superior quality of cocoa and sugar, flavored with pure vanilla bean. Served as a drink, or eaten dry as confectionery, it is a delicious article, and is highly recommended by tourists.

Sold by Grocers everywhere.

W. BAKER & CO., Dorchester, Mass.

GOLD MEDAL, PARIS, 1878.

BAKER'S

Breakfast Cocoa.

Warranted *absolutely pure Cocoa*, from which the excess of Oil has been removed. It has *three times the strength* of Cocoa mixed with Starch, Arrowroot or Sugar, and is therefore far more economical, *costing less than one cent a cup.* It is delicious, nourishing, strengthening, easily digested, and admirably adapted for invalids as well as for persons in health.

Sold by Grocers everywhere.

W. BAKER & CO., Dorchester, Mass.

FORTY-THIRD ANNUAL REPORT OF THE

NEW YORK LIFE INSURANCE CO.

Office: Nos. 346 & 348 BROADWAY, NEW YORK.

JANUARY 1, 1888.

Amount of Net Assets, January 1, 1887.....$71,619,693.48

REVENUE ACCOUNT.

Premiums	$19,233,519.37	
Less deferred premiums, January 1, 1887	1,041,646.15	$18,191,873.22
Interest and rents, etc.	4,252,480.50	
Less interest accrued, January 1, 1887	496,497.10	3,755,983.40 — $22,003,791.19

DISBURSEMENT ACCOUNT.

$93,872,410.60

Losses by Death, and Endowments matured and discounted (including reversionary additions to same)		$4,321,365.16
Dividends (including matured dividends), annuities, and purchased insurances		3,176,543.24
Total paid policy-holders	$7,497,910.19	
Taxes and re-insurances		234,425.39
Commissions (including advanced and commuted commissions), brokerages, agency expenses, physicians' fees, etc.		3,331,775.05
Office and law expenses, salaries, advertising, printing, etc.		930,280.56 — $12,993,088.43

ASSETS.

$79,919,317.17

Cash on deposit, on hand, and in transit		$3,098,299.40
United States Bonds and other bonds and stocks (market value, $32,255,814.98)		47,156,213.14
Real Estate		5,867,872.50
Bonds and Mortgages, first lien on real estate (buildings thereon insured for $14,000,000 and the policies assigned to the Company as additional collateral security)		15,948,472.78
Temporary Loans (market value of securities held as collateral, $2,404,856)		1,997,560.00
*Loans on existing policies (the Reserve on these policies, included in Liabilities, amounts to over $9,000,000)		866,799.44
*Quarterly and semi-annual premiums on existing policies, due subsequent to January 1, 1888		1,174,940.96
*Premiums on existing policies in course of transmission and collection. (The Reserve on these policies, included in Liabilities, is estimated at $1,800,000)		899,156.66
Agents' balances		176,792.82
Accrued Interest on investments, January 1, 1888		433,477.50 — $79,919,317.17
Market value of securities over cost value on Company's books		3,787,328.68

*A detailed schedule of these items will accompany the usual annual report filed with the Insurance Department of the State of New York.

TOTAL ASSETS, January 1, 1888.....$83,079,845.85

APPROPRIATED AS FOLLOWS:

Approved losses in course of payment		$297,078.35
Reported losses awaiting proof, etc.		292,314.54
Matured endowments, due and unpaid (claims not presented)		27,562.20
Annuities due and unpaid (claims not presented)		12,042.06
Reserved for re-insurance on existing policies; participating insurance at 4 per cent Carlisle net premium; non-participating at 5 per cent Carlisle net premium	$69,396,440.00	
Additional amount of Reserve (transferred from Surplus account) required on account of new State Standard of valuation (Actuaries' 4 per cent), taking effect December 31, 1887	1,392,269.00	70,888,709.00
Reserved for contingent liabilities in Tontine Dividend Fund, January 1, 1888, over and above a 4 per cent Reserve on existing policies of that class	4,176,425.25	
Addition to the Fund during 1887	1,795,602.54	
	$5,972,027.79	
DEDUCT—		
Returned to Tontine policy-holders during the year on matured Tontines	646,306.96	
Balance of Tontine Fund, January 1, 1888		5,325,720.83
Reserved for premiums paid in advance		24,326.73
		$76,428,285.76
Divisible Surplus (Company's new Standard)		6,651,560.11
		$83,079,845.85

Surplus by the present New York State Standard, i. e., 4 per cent Actuaries' (including the Tontine Fund).....$11,246,793.06

From the undivided surplus, as above, the Board of Trustees has declared a Reversionary dividend to participating policies in proportion to their contribution to surplus, available on settlement of next annual premium.

Number of Policies issued during the year, 28,522. Risks assumed, $106,760,396.

Total number of Policies in force December 31, 1887, 113,283. Amount at risk, $363,935,536.

TRUSTEES:

WM. H. APPLETON,	HENRY BOWERS,	ELIAS S. HIGGINS,	GEORGE H. POTTS,	W. F. BUCKLEY,
WILLIAM H. BEERS,	JOHN CLAFLIN,	WALTER H. LEWIS,	C. C. BALDWIN,	HENRY TUCK,
WILLIAM A. BOOTH,	ROBERT B. COLLINS,	EDWARD MARTIN,	JOHN N. STEARNS,	A. H. WELCH,
HON. REED. H. SANDFORD,	ALEX. STUDWELL,	RICHARD MCCOS,	WM. L. STRONG,	R. L. WEEKS.

THEODORE H. BANTA, Cashier.
A. HUNTINGTON, M.D., Medical Director.

WILLIAM H. BEERS, President.
HENRY TUCK, Vice-President.
ARCHIBALD H. WELCH, 2d Vice-President.
RUFUS W. WEEKS, Actuary.

12 F